EVALUATION OF CONFIGURATION MANAGEMENT PRACTICES IN THE NATIONAL AIRSPACE SYSTEM

NAS Configuration Management and Evaluation Staff
Program Evaluation Branch (ACM-10)

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Executive Summary

Configuration management, defined as "a process for establishing and maintaining consistency of a product's performance, functional and physical attributes with its requirements, design, and operational information throughout its life", is one of the Federal Aviation Administration's (FAA) core responsibilities in maintaining the NAS. Configuration management includes identifying and documenting configuration items, recording and tracking changes or modifications to these items, and ensuring appropriate control over them at all times. Configuration management also requires the coordination efforts of many stakeholders during the process where subject matter experts review and comment on proposed changes to configuration items.

The Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1) requested that the NAS Configuration Management and Evaluation Staff's Program Evaluation Branch (ACM-10) conduct an evaluation on the current status of configuration management in the National Airspace System (NAS). The final report was to provide ARA-1 and ATS-1 with a view of the current configuration management environment from the NAS level down to the Facility level. To accomplish this, ARA-1 and ATS-1 requested that the evaluation team conduct case studies on systems with varying levels of configuration management maturity.

The objectives of this evaluation were to (1) identify the core attributes of effective configuration management and (2) determine the range of configuration management practices in ARA and ATS through case studies, including the causes of disparities between mature and less mature configuration management practices.

The evaluation team used a combination of documentation review, analysis, and stakeholder interviews to perform the evaluation. The team began by identifying the core attributes of effective configuration management activities with which to analyze configuration management practices from the NAS level to the Facility level. The team identified eight core attributes, listed in Table ES-1 below.

Core Attributes of an Effective Configuration Management Process	
1	Practices result in requirements being traceable from the NAS level to the service and product levels.
2	The strategy is established and roles and responsibilities are clearly defined and communicated.
3	Configuration management is planned and performed over the product's lifecycle.
4	Activities are repeatable, measurable, and flexible.
5	Configuration items are uniquely identified and baselined and the information is maintained in a repository.
6	Changes to the NAS configuration are recorded, tracked, reviewed, approved, and reported.
7	Audits and inspections, including contractor activities, are conducted and documented.
8	Training is provided.

Table ES-1. Core Attributes of an Effective Configuration Management Process

Next, the team divided NAS configuration management practices into two broad categories: NAS-level configuration management practices and Integrated Product Team (IPT)/Business Unit/Operational Support[1]/Regional/ Facility-level configuration management practices. We undertook a comprehensive

[1] *Operational organizations include AOS, ANI, AML, AOP, and AFZ.*

review of NAS-level configuration management practices. Due to the size of the universe of IPT/Business Unit-level and below configuration management practices, the team used three case studies to determine the range of configuration management practices across programs.

To select the case studies, the evaluation team researched 99 programs to identify those that best reflected the range of NAS configuration management practices. Our approach entailed evaluating a program with "more mature" configuration management practices and one with "less mature" configuration management practices. The team selected the programs for case study by applying four criteria: configuration management maturity (as measured by the integrated Capability Maturity Model level), status of systems (deployed and operational), lifecycle phase, and location of systems. After applying these criteria, two programs from the Office of Air Traffic Systems Development (AUA) were selected: Display System Replacement (DSR) and Automated Weather Observing System (AWOS). To ensure that configuration management practices in the Office of Communications, Navigation, and Surveillance Systems (AND) also were considered in the evaluation, ACM-1 asked the evaluation team to include Enhanced Terminal Voice Switch (ETVS) as a third case study.

Based on responses from interviews with over 100 stakeholders, in total, at all levels of the configuration management process and analysis of supporting documentation, the evaluation team developed ten findings that discuss the FAA's current configuration management practices and how these practices compare to the core attributes of an effective configuration management process.

Findings and Recommendations

Overall, the evaluation team concluded that although many positive configuration management practices were identified, there is significant room for improvement. One major area identified for improvement was the need for more stakeholder involvement, particularly in high-level configuration management decisions. Many of the findings and recommendations below reflect the need for selecting a group of stakeholders for collaboration with ACM-20 on issues affecting configuration management across the agency. To address this need, the recommendations focus specifically on more involvement from the existing cross-organizational team, the Configuration Management Steering Group (CMSG), in broad configuration management decisions.

ARA-1 and ATS-1 established the CMSG to guide the development, implementation, and operation of NAS configuration management. The CMSG is chaired by ACM-1 and comprised of senior managers across the agency. This group is responsible for developing high-level configuration management strategies and goals that tie to ARA-1 and ATS-1 performance goals. The CMSG created a cross-functional Configuration Management Core Team to work closely with ACM-20 in leading configuration management initiatives and making recommendations on their implementation. The CMSG also establishes working groups, when needed, to resolve configuration management issues.

The evaluation team identified ten overall findings and offered 31 recommendations to address these configuration management issues as follows:

Finding #1. Configuration Management Is Not Fully Conducted In The Early Phase Of The Acquisition Management System Lifecycle.

Recommendations:

1. The NAS Configuration Control Board (CCB) and ASD should make completing the Technical Architecture and placing it under configuration control a top priority.
2. ARS should develop case files to place the Final Requirements Document under configuration control after JRC approval.

3. ARS should develop case files when proposing changes to a baselined Final Requirements Document to ensure NAS CCB review of any technical changes.

Finding #2. Locally Developed Systems Are Not Placed Under Configuration Control Prior To Installation.

Recommendations:

4. ARA-1 and ATS-1 should establish a NAS requirements function at the corporate level to lead the development, management, and validation of system requirements throughout the product lifecycle. [This recommendation relates to a requirements management issue that surfaces in the change control process.]
5. Integrated Product Team/Business Units should work with the Regions and Facilities to identify local systems that have not been baselined and ensure that these systems are placed under configuration control.
6. The Regions and Facilities should submit case files to the NAS CCB requesting that local systems be tested and baselined.
7. Regional Configuration Management Plans, developed in accordance with FAA Order 1800.66, should address how local systems should be evaluated and placed under configuration control prior to installation.

Finding #3. Configuration Management Roles And Responsibilities Are Not Well Defined And Communicated At The Regional And Facility Levels.

Recommendations:

8. ACM-20 should revise FAA Order 1800.66 to provide further detail on the agency's modification process and how it fits into the overall configuration management process.
9. AFZ-700 should distribute to the Regions the recently completed overall Regional Configuration Management plan (FAA-STD-058) that was approved by the NAS CCB.
10. The Regions should prepare their own Configuration Management plans, including Facility roles and responsibilities, and provide these plans to the Facilities. The Regional Configuration Management plans should be incorporated into the appendices of FAA Order 1800.66.

Finding #4. The NAS Change Control Process Is Well Documented At All Levels, Although Stakeholders Find The Process Cumbersome.

Recommendations:

11. ACM-20, working in conjunction with the Configuration Management Core Team, should examine the must evaluation phase of the change control process. This examination should focus on criticisms that there are too many evaluators reviewing case files, evaluators take an excessive amount of time to provide comments, and some evaluators fail to provide comments at all.
12. ACM-20, working in conjunction with the Configuration Management Core Team, should establish a working group to develop criteria for classifying change proposals into Class I and Class II categories.
13. Stakeholders, working in conjunction with ACM-20, should continue to pursue process-related initiatives to make the change control process less cumbersome.

Finding #5. FAA's Airway Facilities Service Modification Data Does Not Accurately Or Completely Reflect Changes To The NAS.

Recommendations:

14. In accordance with FAA Order 6032.1B, Facilities should update the Maintenance Management System and the Facility Reference Data File with the current status of modification implementation.

15. In accordance with FAA Order 6032.1B, Regions should ensure that Facilities are updating the Maintenance Management System and the Facility Reference Data File with the current status of modification implementation.
16. AOP-100 should continue working with stakeholders to improve the functionality of the Maintenance Management System.
17. ACM-20 should continue assisting AOP-100 in communicating Maintenance Management System improvements to stakeholders through teleconferences and the national configuration management website.

Finding #6. The Documentation and Configuration Identification System Does Not Reflect The Actual Status Of Certain Configuration Control Decisions.

Recommendations:

18. ACM-20, working in conjunction with the Airway Facilities Service, should continue to pursue electronic transmission of modification data between the Maintenance Management System and the new WebCM tool to ensure that modification status is available prior to closing Configuration Control Decisions.
19. AOS should not close Configuration Control Decision actions until Facilities have installed all applicable modifications associated with a Configuration Control Decision.
20. ACM-20, working in conjunction with the Configuration Management Core Team, should simplify the procedure for withdrawing action items in the Configuration Control Decision that are no longer feasible.
21. ACM-20, working in conjunction with the Configuration Management Core Team, should develop general guidelines for establishing completion dates for action items in the Configuration Control Decision.
22. AOS and AOP should brief the Director of Airway Facilities Service regularly on the status of open Configuration Control Decisions in the Airway Facilities Service organization.

Finding #7. FAA's Airway Facilities Service Does Not Regularly Conduct Configuration Status Audits On Deployed Systems.

Recommendations:

23. The Regions should conduct regularly scheduled Facility configuration status audits to verify that modifications have been installed and properly recorded in the Maintenance Management System and the Facility Reference Data File.
24. The Regions should brief the Director of Airway Facilities Service regularly on the results of configuration status audits.

Finding #8. Configuration Management Training Varies Widely Among Stakeholders.

Recommendations:

25. ACM-20, working in conjunction with the Configuration Management Core Team, should complete the Configuration Management Training Plan, obtain CMSG endorsement of the plan, and distribute it to configuration management stakeholders throughout the agency. The training plan should include details regarding the expertise stakeholders need to acquire at each level in the configuration management process and the training resources available to gain this expertise.
26. ACM-20 should update the configuration management website to include those training opportunities identified in the Configuration Management Training Plan.

Finding #9. The FAA Does Not Have A Corporate Strategy for the Configuration Management Process.

Recommendations:

27. The Configuration Management Steering Group should develop a corporate configuration management strategy that establishes performance goals and provides an implementation plan for

achieving these goals. The corporate strategy, performance goals, and implementation plan should be updated annually and communicated to stakeholders.

28. ARA-1 and ATS-1 should re-evaluate the composition of the Configuration Management Steering Group to determine whether managers at the appropriate level are included as permanent members of the group.
29. The Configuration Management Steering Group should meet regularly to address ongoing cross-functional configuration management issues.

Finding #10. Performance Metrics Are Not Tied To Corporate-Level Performance Goals For The Configuration Management Process.

Recommendations:

30. After developing corporate-level performance goals, the Configuration Management Steering Group should endorse outcome-oriented performance metrics that will be used to evaluate the FAA's success in achieving these performance goals.
31. ACM-20 should ensure that stakeholders in the configuration management process have the capability needed to efficiently collect and report performance metrics to the appropriate management level.

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Introduction

Background

Configuration management, defined as "a process for establishing and maintaining consistency of a product's performance, functional and physical attributes with its requirements, design, and operational information throughout its life"[2], is one of the FAA's core responsibilities in maintaining the NAS. Configuration management includes identifying and documenting configuration items, recording and tracking changes or modifications to these items, and ensuring appropriate control over them at all times. Configuration management also requires the coordination efforts of many stakeholders where subject matter experts review and comment on proposed changes to configuration items.

The Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1) requested that the NAS Configuration Management and Evaluation Staff's Program Evaluation Branch (ACM-10) conduct an evaluation on the current status of configuration management in the Federal Aviation Administration (FAA). The final report was to provide ARA-1 and ATS-1 with a view of the current configuration management environment from the National Airspace System (NAS) level down to the Facility level. To accomplish this, ARA-1 and ATS-1 requested that the evaluation team conduct case studies on systems with varying levels of configuration management maturity.

In 1997, the FAA Administrator formed the NAS Configuration Management and Evaluation Staff (ACM) to manage the agency's configuration management process. In November 1999, the Administrator issued FAA Order 1800.66, Configuration Management Policy, to standardize configuration management practices throughout the agency. However, subsequent studies conducted by the NAS Configuration Management Branch (ACM-20) and the Airway Facilities Evaluation Staff (AAF-20) have continued to identify problems with the application of the configuration management policy at various levels of the agency.

ARA-1 and ATS-1 established the Configuration Management Steering Group (CMSG) in November 1998 to guide the development, implementation, and operation of NAS configuration management. The CMSG is chaired by ACM-1 and comprised of senior managers across the agency. This group is responsible for developing high-level configuration management strategies and goals that tie to ARA-1 and ATS-1 performance goals. The CMSG created a cross-functional Core Team to work closely with ACM-20 in leading configuration management initiatives and making recommendations on their implementation. The CMSG also establishes working groups, when needed, to resolve configuration management issues.

Objectives

The objectives of this evaluation were to (1) identify the core attributes of effective configuration management and (2) determine the range of configuration management practices in ARA and ATS through case studies, including the causes of disparities between mature and less mature configuration management practices.

Scope/Methodology

The evaluation team used a combination of documentation review, analysis, and stakeholder interviews to perform the evaluation. The team began by identifying the core attributes of effective configuration

[2] *Military Handbook 61*

management activities with which to analyze configuration management practices from the NAS level to the Facility level. Then, the team divided NAS configuration management practices into two broad categories: NAS-level configuration management practices and Integrated Product Team (IPT)/Business Unit/Operational Support[3]/Regional/Facility-level configuration management practices. We undertook a comprehensive review of NAS-level configuration management practices. Due to the size of the universe of IPT/Business Unit-level and below configuration management practices, the team used case studies to determine the range of configuration management practices across programs. The specific methodology is discussed below.

Core Attributes

The evaluation team identified eight core attributes of an effective configuration management process by researching industry standards (Military Handbook 61 and the Electronic Industries Alliance (EIA)-649, Standard National Consensus Standard for Configuration Management) as well as FAA Order 1800.66, Configuration Management Policy. ACM-20 confirmed that the eight core attributes identified were accurate and complete. These core attributes were used to measure the FAA's configuration management practices. The core attributes are listed in Table 1 below. For a more detailed explanation of the Core Attributes, see Appendix A.

Core Attributes of an Effective Configuration Management Process	
1	Practices result in requirements being traceable from the NAS level to the service and product levels.
2	The strategy is established and roles and responsibilities are clearly defined and communicated.
3	Configuration management is planned and performed over the product's lifecycle.
4	Activities are repeatable, measurable, and flexible.
5	Configuration items are uniquely identified and baselined and the information is maintained in a repository.
6	Changes to the NAS configuration are recorded, tracked, reviewed, approved, and reported.
7	Audits and inspections, including contractor activities, are conducted and documented.
8	Training is provided.

Table 1- Core Attributes of an Effective Configuration Management Process

NAS-Level Configuration Management Practices

To evaluate NAS-level configuration management practices, the team performed a comprehensive analysis using a combination of documentation review and interviews. The team reviewed documentation provided by the NAS Configuration Control Board (CCB), the Office of System Architecture and Investment Analysis (ASD), Air Traffic Requirements Service (ARS), and ACM-20. We also interviewed NAS-level configuration management stakeholders from 10 organizations. These organizations are listed in Table 2. Using these data, the team evaluated NAS-level configuration management practices by comparing the FAA practices to the eight core attributes described above.

[3] *Operational organizations include AOS, ANI, AML, AOP, and AFZ.*

Organizations Interviewed for NAS-Level Configuration Management Practices	
Air Traffic Requirements Service (ARS)	Research and Requirements Directorate (ARQ)
NAS Implementation Program (ANI)	NAS Planning and Support Division (AFZ-700)
Airway Facilities Service (AAF)	Office of System Architecture and Investment Analysis (ASD)
NAS Operations Division (AOP-100)	NAS Configuration Management Branch (ACM-20)
NAS In-Service Management Division (AOP-1000)	Terminal Business Service (ATB)

Table 2- Organizations Interviewed for NAS-Level Configuration Management Practices

IPT/Business Unit, Operational, Regional, and Facility-Level Configuration Management Practices

To evaluate configuration management practices from the IPT/Business Unit level to the Facility level, the team used case studies to identify the range of configuration management practices in place.

Case Studies

The evaluation team researched 99 programs[4] to identify those that best reflected the range of NAS configuration management practices. Our approach entailed evaluating a program with "more mature" configuration management practices and one with "less mature" configuration management practices. The process for choosing case study programs is illustrated in Figure 1 and discussed below.

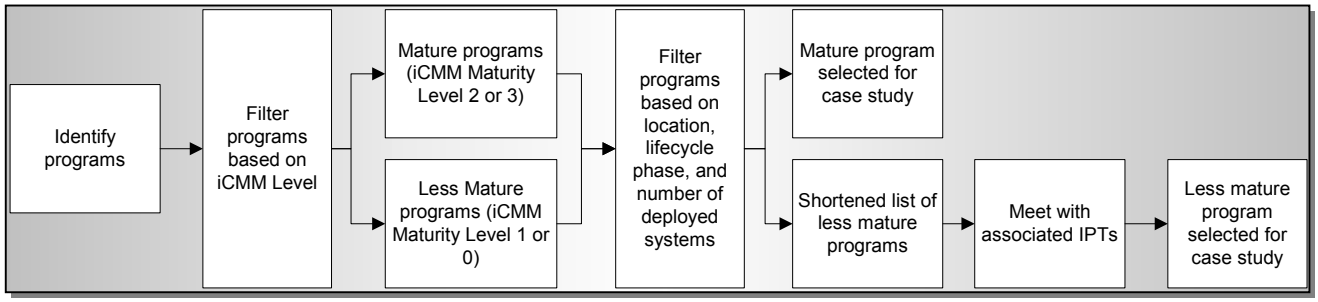

Figure 1- Process for Selecting Programs in Case Studies

To choose the case study that represented more mature configuration management practices, we reviewed a list of the programs implementing integrated Capability Maturity Model (iCMM) process improvement that included each program's current maturity level for the configuration management process area. Programs with maturity levels of 2 or higher were considered more mature in terms of configuration management practices. Only 18 programs had reached this level, with two of the 18 programs pursuing maturity level 3. Since one of these two programs had been reviewed in an earlier study, we selected the other program pursuing maturity level 3, Display System Replacement (DSR), for the case study representing more mature configuration management practices.

In choosing the case study that represented less mature configuration management practices, the evaluation team sorted the remaining 81 programs with maturity levels of zero or 1 for the configuration management process area by lifecycle phase, status of systems (deployed and operational), and location. See Table 3 for more detailed discussion of these criteria. We consulted with configuration management subject matter experts to narrow the number of candidate programs to 26. Next, we contacted the

4 *ACM-10 identified the 99 programs through a review of integrated Capability Maturity Model (iCMM) documentation, Configuration Control Board charters, and various sources within the FAA intranet.*

associated IPTs for configuration management documentation from their respective representatives. The evaluation team interviewed IPT personnel and reviewed information provided by the IPTs. The team chose Automated Weather Observing System (AWOS) as the case study of a program with less mature configuration management practices. This product team had not pursued iCMM for AWOS process improvement and was unable to provide configuration management documentation for the system.

DSR and AWOS also met the additional criteria listed in Table 3.

	Criteria For Selecting Case Studies to Represent More Mature or Less Mature Configuration Management Practices
1	The product/program's level of configuration management maturity as measured by the product's iCMM level. A product was deemed mature if configuration management was included in its iCMM process and the product had reached Level 2 and was pursuing Level 3. A product was considered less mature if configuration management was not included in its iCMM process or if configuration management was included in its iCMM process and the product team had reached Level 1 for that process area.
2	The product/program's Deployment Status. Because the evaluation team was tracing configuration items down to the Regional and Facility levels, it must use programs that were in either the Solution Implementation or the In-Service Management lifecycle phase of AMS.
3	The product/program's distribution. The team wanted programs that were widely distributed throughout the NAS. A program was considered widely distributed if it had been deployed to 20 or more sites or 5 or more Regions.
4	The product/program's locations. Because the evaluation team needed to travel to multiple sites, a number of systems needed to be located somewhat near the Regional offices the team visited.

Table 3- Criteria for Selecting Case Studies to Represent More Mature or Less Mature Configuration Management Practices

Since DSR and AWOS were both managed by AUA, ACM-1 asked the evaluation team to include Enhanced Terminal Voice Switch (ETVS) as a third case study to ensure that configuration management practices in AND also were considered in the evaluation. The evaluation team determined that the maturity of ETVS' configuration management activities lay between those of DSR and AWOS.

Data Collection

Once the case studies were selected, the team collected configuration management data for each program. The applicable IPTs and their CCBs, as well as the second level engineering support organizations, provided configuration management documentation for each of the case studies. The evaluation team also interviewed stakeholders from each of these organizations.

In addition, the evaluation team selected three Regions for site visits. The Regions were selected based on the number of AWOS, DSR, and ETVS Facilities located within driving distance of the Regional office. The Regions selected were Eastern Region, Southern Region, and Western-Pacific Region. As a part of these site visits, the evaluation team also visited various Facilities that had AWOS, DSR, or ETVS installed. We interviewed the following configuration management practitioners during each visit:

- CCB Chairpersons and Executive Secretariats
- Configuration Management Coordinators
- Regional Modification Coordinators

- AOS Engineers
- Facility Managers
- System Technicians

The evaluation team interviewed a total of over 100 stakeholders at the NAS, IPT/Business Unit, Operational, Regional, and Facility levels, who provided candid comments, insightful recommendations, and honest feedback on the configuration management process.

Data Analysis

Once the data were assembled and analyzed compared the configuration management practices at all levels to those practices described in the core attributes for effective configuration management. Figure 2 describes this process.

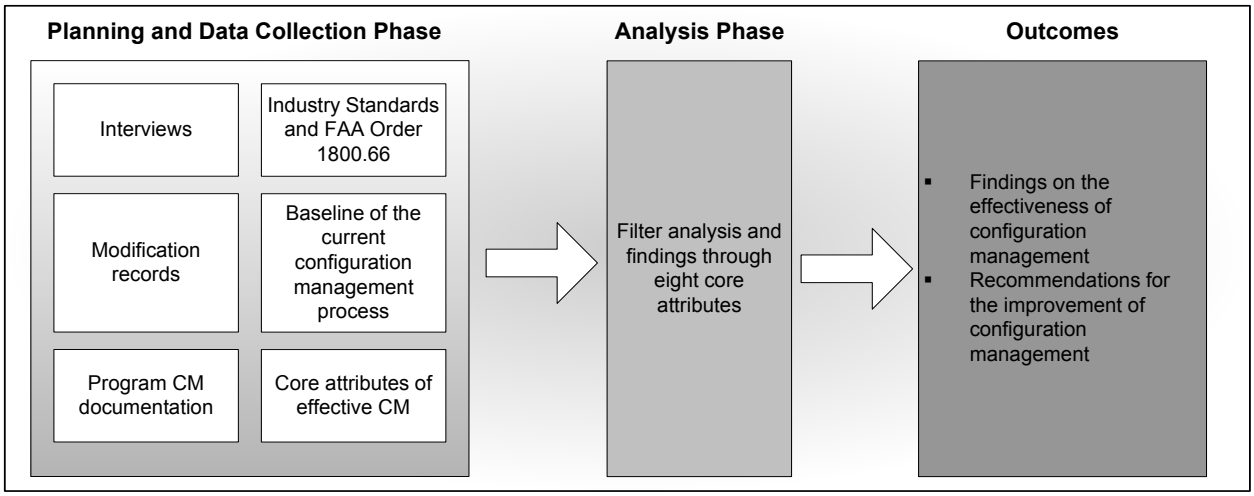

Figure 2- ACM-10's Data Analysis Process

The case studies in Appendix B provide a detailed analysis of configuration management practices at the IPT, Operational, Regional, and Facility levels and a summary of the team's conclusions and outstanding issues.

Based on the responses from interviews with a total of over 100 stakeholders at all levels of the configuration management process and analysis of supporting documentation, we developed ten findings that discuss the FAA's current configuration management practices and how these practices compare to the core attributes of an effective configuration management process. Table 4 links each finding to the appropriate core attribute(s).

Report Findings	Core Attributes							
	1-Requirements Traceability	2-CM Strategy & Roles & Responsibilities Defined & Communicated	3-CM Planned & Performed over Lifecycle	4-CM Activities Repeatable, Measurable, & Flexible	5- Configuration Items Identified, Baselined, & in a Repository	6-NAS Changes Recorded, Tracked, Reviewed, Approved, & Reported	7-Configuration Audits & Inspections Conducted and Documented	8-CM Training Provided
1. CM is not fully conducted in the early phase of the AMS lifecycle.	X		X		X	X		
2. Local systems are not placed under configuration control prior to installation.	X		X		X	X		
3. CM roles & responsibilities are not well defined and communicated at the Regional and Facility levels.		X		X	X			
4. The NAS change control process is well documented at all levels, although stakeholders find the process cumbersome.				X		X		
5. FAA's modification data does not accurately or completely reflect changes to the NAS.			X			X		
6. DOCCON does not reflect the actual status of Configuration Control Decisions.			X			X		
7. Airway Facilities Service does not regularly conduct configuration status audits for deployed systems.							X	
8. CM training varies widely among stakeholders.								X
9. The FAA does not have a corporate strategy for the CM process.		X						
10. Performance metrics are not tied to corporate-level performance goals for the CM process.				X				

Table 4- Report Findings Linked to Core Attributes

Constraints

The overall constraint is that this evaluation does not address issues related to configuration management that are outside the scope of our objectives. For example, the FAA lacks a complete inventory of NAS assets. The NAS Architecture provides a high-level listing of NAS services and capabilities and the Documentation and Configuration Identification System (DOCCON) includes configuration items that have been placed under configuration control (i.e., baselined). However, there is no central repository that contains an inventory of all NAS equipment, including subsequent modifications to these systems.

A second constraint is that some of the evaluation results are based on case studies. The evaluation team determined the range of configuration management practices by conducting case studies on three programs that represented a range of maturity in configuration management activities. While the case studies do not comprise a statistically significant sample of programs in the FAA, the case studies do provide an accurate illustration of configuration management practices throughout the agency.

A third constraint is that, organizationally, ACM-10 is not independent of ACM-20 because both groups ultimately report to the ACM-1 Program Director. However, the evaluation team conducted interviews, data collection, and analysis in an independent and objective manner. The findings discussed in the following pages of this report will relate to many organizations, including ACM-20.

Findings

1. Configuration Management Is Not Fully Conducted In The Early Phase Of The Acquisition Management System Lifecycle

Configuration management is not fully conducted in the early phase of the Acquisition Management System (AMS) lifecycle because the Final Requirements Document (fRD) is not placed under formal configuration control after Joint Resources Council (JRC) approval. Also, the NAS CCB does not review proposed changes to the fRD and make recommendations to the JRC. As a result, there is no formal oversight of technical requirements changes to ensure traceability from the NAS level to the service and product levels. Figure 3 illustrates the missing traceability in the FAA's current change process:

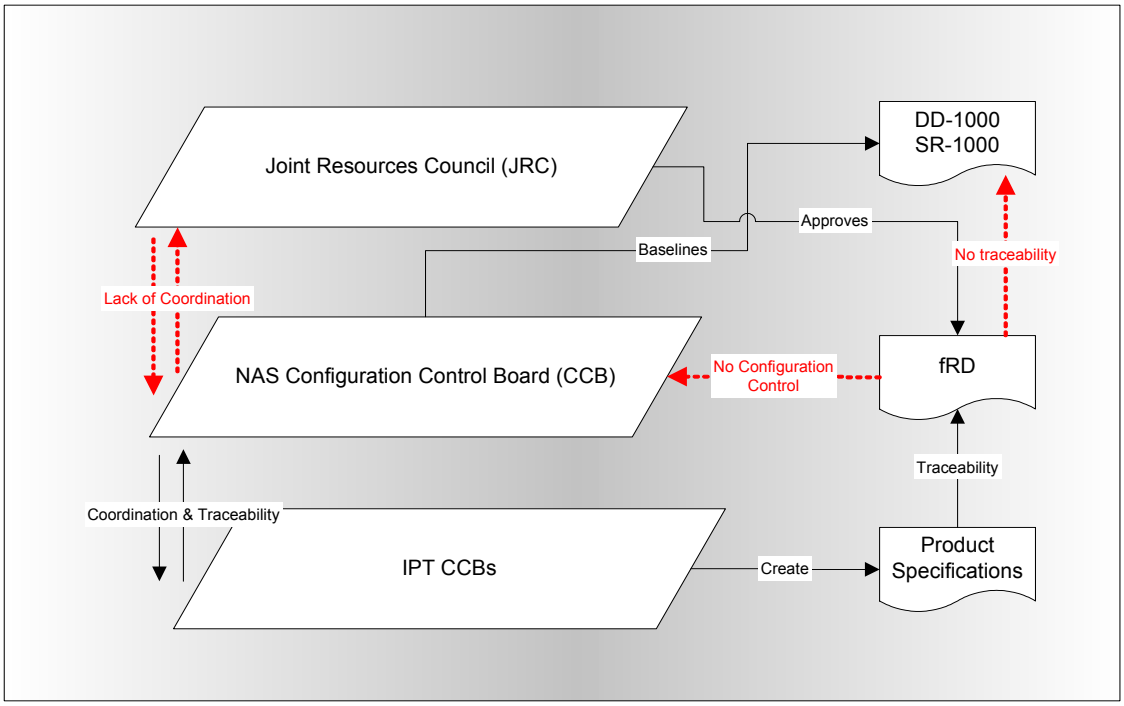

Figure 3- Traceability in the Change Control Process

ARS and ASD are responsible for developing and reviewing the fRD during the Investment Analysis phase of the lifecycle. The fRD describes the top-level requirements necessary to meet the needs included in the Mission Needs Statement and drives the creation of the product specifications from which the IPT/Business Unit and contractor design and build the product. To ensure that requirements in the fRD trace to the NAS-level documents, NAS System Requirements Specification (SR-1000) and NAS Level 1 Design Document (DD-1000), ARS and ASD perform traceability analysis in the Dynamic Object Oriented Requirements System (DOORS). Upon completion, the JRC approves the fRD as part of the final investment decision. After JRC approval, the fRD is supposed to be placed under configuration control as provided in the national configuration management policy. The NAS CCB is responsible for evaluating proposed technical changes to the fRD and making recommendations to the JRC. FAA Order 1800.66, which includes the NAS CCB charter and operating procedures, identifies the fRD as a configuration item under the purview of the NAS CCB to ensure that proposed requirements changes are traceable from the NAS level to the service and product levels.

While the national configuration management policy provides for configuration management throughout the AMS lifecycle, there are several reasons why the policy has not been fully implemented. First, the

NAS level requirements documents (SR-1000 and DD-1000) are outdated and were last revised in March 1985 and March 1996, respectively. There are currently 16 Configuration Control Decisions issued from 1994-2002 that have not been closed out because the SR-1000 and DD-1000 have not been updated. These documents are in the process of being replaced by the "Technical Architecture". The Technical Architecture will be derived from the FAA Concept of Operations, SR-1000, and portions of the DD-1000 and will reflect interfaces and interdependencies between systems. ASD has been developing this architecture over the past few years and plans to release the first segment for NAS CCB review in early FY 2003. However, ASD and ACM-20 have not worked out several issues that need to be addressed before the Technical Architecture can be placed under configuration control. Specifically, they do not agree on what the Technical Architecture will represent when it is completed and how configuration items will be placed under configuration control in the future. Once the Technical Architecture has been approved by the NAS CCB and placed under configuration control, changes to the fRD will be traced to the Technical Architecture. In addition, the Technical Architecture will be updated based on NAS CCB Configuration Control Decisions.

Second, the NAS CCB has taken no action to ensure that fRDs are placed under configuration control and that proposed technical changes are submitted to the NAS CCB through the NCP process. As a result, there is currently no oversight of technical requirements changes to ensure traceability from the NAS level to the service and product levels. This shortfall signifies that Core Attributes 1, 3, 5, and 6 are not fully met at the NAS level because:

- The NAS CCB does not review technical changes to the fRD, and as a result, there is no assurance that requirements are traceable from the NAS level to the service and product levels (Core Attribute 1) and changes to the NAS configuration are not recorded, tracked, reviewed, approved, and reported (Core Attribute 6).
- The fRD is not placed under configuration control after JRC approval, and therefore, configuration management is not planned and performed over the product's lifecycle (Core Attribute 3) and configuration items are not uniquely defined and baselined (Core Attribute 5).

Recommendations

1. The NAS CCB and ASD should make completing the Technical Architecture and placing it under configuration control a top priority.

2. ARS should develop case files to place the Final Requirements Document under configuration control after JRC approval.

3. ARS should develop case files when proposing changes to a baselined Final Requirements Document to ensure NAS CCB review of any technical changes.

2. Locally Developed Systems Are Not Placed Under Configuration Control Prior To Installation

The Regions and Facilities are not placing locally developed systems under configuration control (i.e., baselining) prior to installation. At least two of these systems, the Electronic Flight Strip Transfer System (EFSTS) and the Information Display System (IDS-4), have been widely distributed throughout the NAS without a national baseline. The Regions and Facilities generally procure local solutions because Headquarters may not address field needs and they may not baseline these systems prior to installation because the NAS change control process is viewed as cumbersome. As a result, the NAS Architecture does not consistently reflect these local solutions and their interface with other systems in the NAS. In addition, the IPT/Business Units have to conduct extensive and costly site visits to document local system interfaces and interdependencies prior to installing new equipment. As these local systems become more

widely distributed and national baselines are requested, the NAS change control process becomes overburdened and the IPT/Business Unit, AOS, and Logistics Center's budgets and resources are stretched or no funding is available to cover the cost of lifecycle support. Also, systems providing duplicative functionality and having multiple configurations are installed throughout the NAS.

FAA Order 1800.66 allows for Regions and Facilities to procure and install local solutions. However, these organizations are responsible for submitting case files to the NAS CCB requesting that systems be tested and baselined.

Stakeholders have requested national baselines for EFSTS and IDS-4. However, these systems already have become widely distributed throughout the NAS without NAS CCB approval. The NAS CCB has approved local and test NAS Change Proposals (NCPs) for some of these systems, but is not aware of how many more local systems have been installed without a baseline. A brief synopsis of the history and current status of EFSTS and IDS-4 is provided below:

- EFSTS automates the transfer of flight plan data between the Air Traffic Control Tower and the Terminal Radar Approach Control. This capability is essential at airports where the two Facilities are no longer co-located and is less costly than the drop tubes replaced by the automated system. Stakeholders requested a national baseline in April 2002 and the Terminal Business Unit (ATB) was processing the NCP at the time of evaluation fieldwork. The NAS CCB subsequently approved the EFSTS baseline on November 8, 2002. While ATB plans to provide the software and second-level support for EFSTS, the Regions and Facilities will have to procure their own hardware. In addition, funding and training issues remain unresolved. ATB will not be able to provide funding for EFSTS until FY 2004 and there is no guarantee that the 30 systems planned each year will be funded.

- IDS-4 is an information display system that provides controllers administrative and operational data from FAA and National Weather Service equipment. The Regions and Facilities have procured between 400 and 600 systems and approximately 2600 workstations. IDS-4 has 7 or 8 different hardware configurations. There have been several versions of IDS since its origination: Systems Atlanta Information Display System (SAIDS)-2, which was not Y2K compliant; SAIDS-4; and IDS-5. The In-Service Management Division (AOP-1000) requested a national baseline in July 2000, but ATB does not have the funding or resources to manage this system. ATB is in the process of completing a market survey to determine what solutions are available to integrate the functionality of IDS-4 and similar local solutions (e.g., Terminal Computer Control System (TCCS) and Integrated Control Management System (ICMS)) into one platform for Information Display Monitor and Control. ATB recently completed a business case on this issue, which is currently being reviewed by ATB management.

Stakeholders are aware of other local systems that have been installed without a baseline. They offered two perspectives regarding why local systems are procured. One perspective is that Headquarters does not consider field needs a top priority. Another perspective is that some field requirements are "wants" rather than "needs". This is a requirements management issue that surfaces in the change control process. ACM-10 addressed the requirements issue in its recent report, *Core Attributes of Requirements Management in the Performance Based Air Traffic Organization*, dated June 18, 2002. The evaluation team recommended that the new Air Traffic Organization establish a NAS requirements function at the corporate level to lead the development, management, and validation of system requirements throughout the product lifecycle. The continued procurement of widely distributed local systems highlights the need for FAA management to address the requirements identification and validation process in the agency.

The Regions and Facilities may not request that local systems be baselined because the change control process is viewed as cumbersome. This issue is discussed in Finding 5, including efforts underway to improve the efficiency of the change control process.

Because local systems are not baselined prior to installation, the NAS Architecture may not reflect these local solutions and their interface with other systems in the NAS. For example, while IDS has been listed in the NAS Architecture, EFSTS has not been included. In addition, the IPT/Business Units have to conduct extensive and costly site visits to document local system interfaces and interdependencies prior to installing new equipment. The evaluation team attempted to determine the cost of site visits required due to local adaptations; however, the data was not available. As local systems become more widely distributed, the NAS change control process becomes overburdened with requests for test, local, and national baselines. The NAS CCB is forced to deal with funding and schedule issues outside the board's purview. In addition, the IPT/Business Units, AOS, and the Logistics Center are expected to reallocate their budgets and resources to fund unanticipated spare parts and maintenance. Some of these systems duplicate functionality (e.g., IDS-4, TCCS, and ICMS) and have multiple configurations (e.g., IDS-4) that result in higher operational and maintenance costs.

When local systems are not placed under configuration control prior to installation, Core Attributes 1, 3, 5, and 6 are not fully met as follows:

- There is no assurance that requirements are traceable from the NAS level to the local systems (Core Attribute 1).
- Configuration management activities are not planned and performed over the local system's lifecycle (Core Attribute 3).
- The local system is not uniquely identified and baselined (Core Attribute 5).
- Changes to the NAS configuration are not recorded, tracked, reviewed, approved, and reported (Core Attribute 6).

On September 18, 2002, the Associate Administrator for ATS issued FAA Order 6032.1B, National Airspace System Modification Program, that required the Regions to institute a program for identifying all unauthorized modifications. These modifications are to be authorized in accordance with FAA Order 1800.66 or completely removed from the NAS.

Recommendations

4. ARA-1 and ATS-1 should establish a NAS requirements function at the corporate level to lead the development, management, and validation of system requirements throughout the product lifecycle.

5. Integrated Product Teams/Business Units should work with the Regions and Facilities to identify local systems that have not been baselined and ensure that these systems are placed under configuration control.

6. The Regions and Facilities should submit case files to the NAS CCB requesting that local systems be tested and baselined.

7. Regional Configuration Management Plans, developed in accordance with FAA Order 1800.66, should address how local systems should be evaluated and placed under configuration control prior to installation.

3. Configuration Management Roles And Responsibilities Are Not Well Defined And Communicated At The Regional And Facility Levels

While configuration management roles and responsibilities are well defined and communicated at the NAS, IPT/Business Unit, and Operational levels, the Regions and Facilities have not fully developed and communicated this guidance. FAA Order 1800.66 provides general guidance at each level of the

configuration management process, but each organization is responsible for developing more detailed guidance regarding its roles and responsibilities in the configuration management process. The three Regions visited during our evaluation have not developed Configuration Management Plans because they have been waiting for AFZ-700 to complete an overall Regional plan that will serve as a template.[5] In the interim, Facilities are not clear on their roles and responsibilities in the configuration management process and configuration management practices in the Regions and Facilities are inconsistent.

NAS and IPT/Business Unit Levels

At the NAS level, the configuration management roles and responsibilities of ACM-20 and the NAS CCB are well defined and communicated in FAA Order 1800.66, which includes the NAS CCB's charter and operating procedures. The Order is comprehensive by industry standards and addresses each of the core attributes needed for an effective configuration management process in the FAA. However, as discussed in Finding 1, the NAS CCB is not fulfilling its responsibility for reviewing proposed changes to the fRD and making recommendations to the JRC.

The IPT/Business Unit's roles and responsibilities are also clearly defined and communicated in the Order. The three IPTs in our evaluation had developed Configuration Management Plans and IPT CCB Operating Procedures that sufficiently describe the configuration management roles and responsibilities of the IPT and its Product Teams. In addition, these IPTs have communicated their plans and procedures to staff members performing configuration management activities.

Operational Level

Configuration management roles and responsibilities are defined and communicated at the Operational level. FAA Orders 1800.66 and 6032.1B, National Airspace System Modification Program, address the modification process and the AOS-200 website provides additional guidance. However, FAA Order 1800.66 does not provide detailed guidance on how the modification tracking process fits into the overall configuration management process.

Regional and Facility Level

The three Regions visited during our evaluation have not developed Configuration Management Plans that provide detailed guidance on Regional and Facility roles and responsibilities in the configuration management process. As mentioned previously, the Regions have been waiting for AFZ-700 to complete an overall Regional plan that will serve as a template for developing their own plans. In the interim, Facilities are not clear on their roles and responsibilities in the configuration management process.

The Regions have not provided guidance on how modification tracking fits into the overall configuration management process or how the Facilities should manage locally-procured systems and equipment.

While detailed guidance has not been provided at the Regional level, Regional configuration management coordinators do actively support configuration management activities and initiatives. The coordinators work closely with the field to baseline Facilities and handle change control processing for the Region.

Since configuration management roles and responsibilities are not clearly defined and communicated at the Regional and Facility levels, Core Attributes 2, 4, and 5 are not fully met as follows:

- Regional and Facility roles and responsibilities are not clearly defined and communicated in Configuration Management Plans (Core Attribute 2).

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[5] *After the evaluation fieldwork was completed, AFZ-700 submitted FAA-STD-058 to the NAS CCB for review. The NAS CCB approved the directive at the December 16, 2002 pre-briefing.*

- Configuration management activities are not repeatable at the Regional and Facility levels (Core Attribute 4).
- Configuration item documentation is not consistently maintained in a repository at the Facility level (Core Attribute 5).

Recommendations

8. ACM-20 should revise FAA Order 1800.66 to provide further detail on the agency's modification process and how it fits into the overall configuration management process.

9. AFZ-700 should distribute to the Regions the recently completed overall Regional Configuration Management plan (FAA-STD-058) that was approved by the NAS CCB.

10. The Regions should prepare their own Configuration Management plans, including Facility roles and responsibilities, and provide these plans to the Facilities. The Regional Configuration Management plans should be incorporated into the appendices of FAA Order 1800.66.

4. The NAS Change Control Process Is Well Documented At All Levels, Although Stakeholders Find The Process Cumbersome

While the NAS change control process is well documented from the NAS level down to the Regional level, stakeholders find the process cumbersome. Stakeholders primarily view the process as cumbersome during the must evaluation phase where subject matter experts review the case file and provide comments. Criticisms include too many evaluators reviewing case files, excessive time taken to provide comments, failure to provide comments at all, and a lack of automation in this phase of the process. Stakeholders also find it difficult to obtain information on the status of a change proposal because the national database is not kept current or complete. As a result, stakeholders may avoid the change control process altogether for configuration items requiring a quick turnaround, such as local systems, or may develop an independent change control process.

FAA Order 1800.66 provides detailed procedures for the change control process, from originating case files to documenting actions taken to complete a Configuration Control Decision (CCD). The Order identifies stakeholders who can originate a change proposal and describes different methods for processing case files, depending on the originator. The IPT/Business Units and Regions have used the Order to create CCB Charters, CCB Operating Procedures, and Configuration Management Plans that address their respective roles and responsibilities in the change control process.

NAS CCB statistics support the stakeholders' view that the change control process has been cumbersome over the years. However, stakeholders have been working diligently to improve case file processing time. In the past, the NAS CCB took an average of 242 days to complete "must evaluation" and adjudication of a change proposal. This processing time did not include prescreening reviews that occurred prior to submitting case files to ACM-20. According to ACM-20, stakeholders have worked together to reduce the average processing time for must evaluation and adjudication of change proposals to 90 days. However, prescreening reviews must be added to this processing time. The table below shows the age of pending NAS CCB change proposals as of September 26, 2002. While almost 66 percent of these NCPs have been pending for less than 90 days, 34 percent are still pending over 90 days.

Age of Pending NAS CCB Change Proposals	Number of Pending NAS CCB Change Proposals in Age Category	Percentage of Pending NAS CCB Change Proposals in Age Category
Pending < 30 days	5	14%
Pending ≥ 30 days and < 60 days	13	38%
Pending ≥ 60 days and < 90 days	5	14%
Pending ≥ 90 days and < 180 days	7	20%
Pending 180 days or more	5	14%
TOTAL	**35**	**100%**

Table 5- Percentage of Pending NAS CCB Change Proposals by Age Category

The change control process is not meant to be a quick or easy mechanism for making changes to NAS equipment and documentation. The must evaluation phase needs to include a thorough review of change proposals to determine how these changes will affect NAS systems, including functionality, interfaces, or interdependencies. However, there should be a balance between the need for a thorough review and the need for timely decisions.

Stakeholders are not only concerned about processing time, but also the difficulty in obtaining information on the status of a change proposal because the national database is not current or complete. DOCCON, FAA's national database for baselined configuration items, is difficult for stakeholders to use because it is an older mainframe system. As a result, some organizations do not provide configuration management information to the DOCCON database. One organization, a primary player in configuration management activities, does not use DOCCON for pre-screening activities and requires interfacing organizations to provide documentation by fax or e-mail. The new WebCM tool should alleviate some of the issues related to DOCCON.

Because stakeholders view the change control process as cumbersome, some have avoided the process altogether for systems that require a quick turnaround, such as locally developed systems. Also, the Terminal Business Services (ATB) is in the process of developing its own change control process that will be submitted to ACM-20 for final approval.

Stakeholders are pursing several initiatives to make the change control process less cumbersome:

- Stakeholders are pursuing the classification of change proposals into Class I and Class II categories. While FAA Order 1800.66 provides that certain change proposals do not require CCB approval, ACM-20 and other organizations do not agree on which change proposals fall into this category. Class I changes require formal CCB approval because they affect interfacing systems or a product baseline, while Class II changes do not. By clearly distinguishing between these two classifications, Operational organizations and the Regions could manage Class II changes without CCB involvement, thereby reducing the workload of the CCBs, including the NAS CCB. ACM-20 will need to work with stakeholders to develop criteria for Class I and Class II changes.

- The new WebCM tool being procured by ACM-20 will automate the change control process, from originating case files to adjudicating change proposals. The tool will provide transparency in the process where stakeholders involved in prescreening, must evaluation, and decision-making can determine where a case file is located at any time during the process. Must evaluators and decision-makers will be able to provide comments and decisions on case files electronically. CCB agendas and meeting minutes will be automated also.

- Stakeholders are pursuing changes within their organizations to reduce change control processing time. As mentioned earlier, the NAS CCB has worked with stakeholders to reduce the average

NCP processing time to an average of 90 days. AOS has developed a documentation-tracking tool that identifies bottlenecks in the process and has taken steps to reduce or eliminate these delays. AOP-1000 has developed a web site that monitors the organization's NCP processing time and has taken steps to reduce processing time in various stages of the process. The web site also allows other CCBs to determine where an NCP is located within AOP's change control process at any time.

Since the change control process is well documented at all levels, Core Attributes 4 and 6 are partially met as follows:

- The change control process is repeatable because it is well documented in FAA Order 1800.66, CCB Charters and Operating Procedures, Configuration Management Plans, and organizational operating procedures (Core Attribute 4).
- The change control process is flexible in that FAA Order 1800.66 provides for certain changes to be managed at the Operational or Regional levels (Core Attribute 4).
- For the most part, changes to the NAS configuration are recorded, tracked, reviewed, approved, and reported (Core Attribute 6).

However, because some stakeholders view the change control process as cumbersome, Core Attributes 4 and 6 are not fully met as follows:

- The change control process is not flexible in that FAA Order 1800.66 does not provide enough information to determine whether certain changes require CCB approval (Core Attribute 4).
- When stakeholders avoid or circumvent the change control process, changes to the NAS configuration are not recorded, tracked, reviewed, approved, and reported (Core Attribute 6).

Recommendations

11. ACM-20, working in conjunction with the Configuration Management Core Team, should examine the must evaluation phase of the change control process. This examination should focus on criticisms that there are too many evaluators reviewing case files, evaluators take an excessive amount of time to provide comments, and some evaluators fail to provide comments at all.

12. ACM-20, working in conjunction with the Configuration Management Core Team, should establish a working group to develop criteria for classifying change proposals into Class I and Class II categories.

13. Stakeholders, working in conjunction with ACM-20, should continue to pursue process-related initiatives to make the change control process less cumbersome.

5. FAA's Airway Facilities Service Modification Data Does Not Accurately Or Completely Reflect Changes To The NAS

FAA's Airway Facilities Service modification data does not accurately or completely reflect changes to the NAS because the national database, Maintenance Management System (MMS), and supporting documentation are not kept current or complete. FAA Order 6032.1A, which was in effect at the time of evaluation fieldwork, defined the roles and responsibilities of Airway Facility Services organizations in the modification tracking process, but these procedures were not always followed. For example, Regions rely on the Facilities to keep MMS and supporting documentation current and complete. However, Facilities focus their resources on keeping the NAS equipment in service. Documenting changes to NAS equipment or problems installing modification kits is not a top priority. As a result, stakeholders may

have to rely on site visits or other follow-up actions to determine the status of modifications and also ensure that spare parts inventory levels are sufficient.

FAA Order 6032.1A, which was issued in September 1975 and remained in effect during evaluation fieldwork, defined the roles and responsibilities of Airway Facilities Service organizations in the modification tracking process. Under this directive, AOS is responsible for developing and supplying modification kits to the Logistics Center or directly to Facilities. In some cases, AOS or a contractor may install the modification kit. The Facilities are responsible for logging modifications in MMS upon receipt and closing out the modification record after installation. Technicians are supposed to document any installation difficulties. The Facilities are supposed to install modification kits within six months of receipt and update MMS and supporting documentation, such as the Facility Reference Data File (FRDF), after installation. The Regions are responsible for ensuring that the Facilities keep MMS and supporting documentation current and complete.

Figure 4 illustrates the FAA's modification tracking process in effect at the time of evaluation fieldwork, although not necessarily consistent with the process laid out in FAA Order 6032.1A. Figure 4 includes AOS's recent practice of entering modifications into MMS, which started in June 2002. AOP-100, in conjunction with AOS, initiated this action to ensure that all modifications were included in MMS. Modifications may be generated as a result of Configuration Control Decisions, Problem Technical Reports, or Hardware Discrepancy Reports.

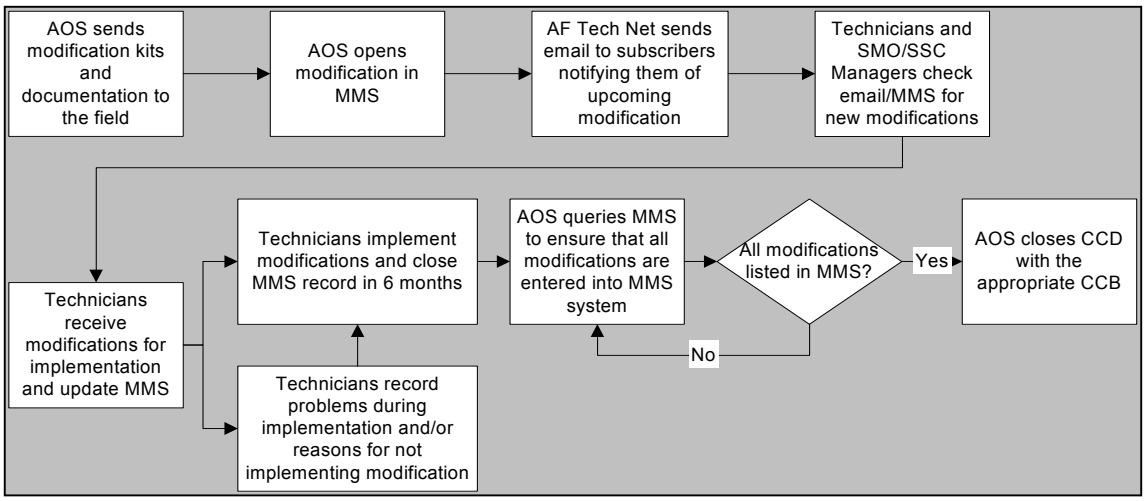

Figure 4- FAA's Current Modification Tracking Process

In September 2002, the FAA canceled Order 6032.1A and implemented Order 6032.1B. The new directive provides that the organization initiating a modification is responsible for entering the Log Equipment Modification (LEM) record in MMS. The directive also states that the Regions are now responsible for reporting the status of NAS modifications to AOS-1, AOP-1, and ACM-1 on a quarterly basis. The directive is consistent with and provides references to FAA Order 1800.66.

Review of Modification Tracking Data in the Case Studies

The evaluation team attempted to determine the accuracy and completeness of modification tracking data for all three case studies, AWOS, DSR, and ETVS, by comparing information from AOS, MMS, and the FRDF. However, ETVS was not used for this comparison since there were no recent modifications to the system. Modification tracking data related to AWOS and DSR is discussed in detail below.

AWOS

AWOS had two modifications, Central Data Platform System Processor (CDP) in March 2000 and Ultra High Frequency Radio Replacement (UHF) in December 2001. AOS's modification tracking data for both modifications matched the FRDF at all seven AWOS sites the evaluation team visited. However, the Facilities had not updated the MMS based on the following results:

- Of the six AWOS sites that were supposed to install the CDP modification, four had updated MMS with the implementation status. The remaining two sites did not install the modification and did not provide this information in MMS.

- Of the four AWOS sites that were supposed to install the UHF modification, only one site had updated MMS with the implementation status. The remaining three sites did not install the modification and did not provide this information in MMS.

DSR

DSR had a total of 48 modifications from February 1998 through March 2002 that applied to one or more of the five Facilities the evaluation team visited. We could not determine whether AOS's modification tracking data matched the FRDF at these sites because AOS could not provide records that distinguished between the operating and application system modifications. Facilities that the evaluation team visited had not updated the FRDF and the MMS based on the following results:

- Three of the five Facilities included less than 40 percent of their modifications in the FRDF. In fact, two of these three Facilities listed less than six percent of their modifications. Of the remaining two Facilities, one included all of its modifications in the FRDF while the other listed over 80 percent of its modifications.

- Three of the five Facilities entered less than 20 percent of their modifications in MMS. In fact, one of these three Facilities included less than two percent of its modifications. Of the remaining two Facilities, one entered 93 percent of its modifications in MMS while the other included 67 percent of its modifications.

The modification data in the FRDF did not always match the information in MMS. In three of the five Facilities, over 13 percent of the modification data in the FRDF did not match the information in MMS. Also, three of the five Facilities did not include data in either the FRDF or MMS for over 55 percent of their modifications.

The AWOS and DSR case studies in Appendix B contain additional information about these modifications.

Facilities do not keep MMS and supporting documentation current or complete for several reasons. First, Facilities focus their resources on keeping the NAS equipment in service. They do not consider documenting changes to NAS equipment or problems installing modification kits a top priority. Second, technicians find it difficult to update MMS because the user interface is cumbersome. Third, technicians do not view updating MMS as an integral part of their job and may not understand how the modification data is used. As a result, stakeholders in the modification tracking process, such as the IPT/Business Units and AOS, have to determine the status of modifications through site visitations or other follow-up actions. Also, the Logistics Center cannot rely on MMS data to maintain a sufficient inventory level of spare parts.

There are also repercussions when Facilities do not install modification kits within the six-month timeframe. The most serious consequence may be system outages. Also, the Logistics Center may have to borrow spare parts intended for other systems or request additional parts that may no longer be

available. In addition, warranties generally expire on modification kits within several years. While failing to install modification kits is more of an operational issue than a configuration management issue, the problems surface during the configuration management process. The Regions conduct technical evaluations on an ad hoc basis to determine whether modifications have been installed. However, the lack of a standardized approach to these evaluations limits their effectiveness.

Airway Facilities Service has taken several actions to encourage Facilities to install modifications in a timely manner and update MMS. The AF Technet and AOS-200 websites provide information about upcoming modifications. AF Technet notifies subscribers when new modifications are released. Also, AOS now enters modifications into LEMS to ensure inclusion in MMS. AOP-100 also continues to work with stakeholders to improve the functionality of MMS; however, several Facilities were unaware of these improvements.

Since FAA's modification data does not accurately or completely reflect changes to the NAS, Core Attributes 3 and 6 are not fully met. The lack of accurate and complete modification data indicates that configuration management is not performed over the product's lifecycle (Core Attribute 3) and changes to the NAS configuration are not tracked and reported (Core Attribute 6).

Recommendations

14. In accordance with FAA Order 6032.1B, Facilities should update the Maintenance Management System and the Facility Reference Data File with the current status of modification implementation.

15. In accordance with FAA Order 6032.1B, Regions should ensure that Facilities are updating the Maintenance Management System and the Facility Reference Data File with the current status of modification implementation.

16. AOP-100 should continue working with stakeholders to improve the functionality of the Maintenance Management System.

17. ACM-20 should continue assisting AOP-100 in communicating Maintenance Management System improvements to stakeholders through teleconferences and the national configuration management website.

6. The Documentation And Configuration Identification System Does Not Reflect The Actual Status Of Certain Configuration Control Decisions

The DOCCON system does not reflect the actual status of certain CCDs because stakeholders close CCDs prematurely or do not close them at all after CCD actions have been completed. According to FAA Order 1800.66, the organization responsible for a CCD action (i.e., action office) is to notify the appropriate CCB Secretariat when a CCD action has been completed, including the installation of all modifications. However, AOS generally closes CCD actions before all modifications have been implemented because Facilities may not install modifications within a reasonable time or document the installation of modifications. On the other hand, action offices may complete CCD actions without notifying the appropriate CCB Secretariat. The CCB Secretariat does not update the CCD status in DOCCON until the action office has confirmed that a CCD action has been completed. As a result, DOCCON does not provide the current NAS configuration, which is needed to plan new acquisitions or modifications and maintain appropriate spare parts inventories.

FAA Order 1800.66 provides specific procedures for CCD closure. The action office is responsible for completing the CCD action and returning the CCD Action Completion Verification Grid to the

appropriate CCB Secretariat for closure. CCB Secretariats are responsible for initiating CCD actions and monitoring their status. This includes updating DOCCON to reflect the closure of completed actions. ACM-20's role is to monitor the timely closure of completed CCD actions in DOCCON.

DOCCON does not reflect the actual status of certain CCDs because AOS generally closes CCDs after the modification kit has been assembled and sent to the field. AOS closes the CCD because Facilities may not install modifications within a reasonable time or document that modifications have been installed. The AWOS case study provides a good example. According to AOS records, not all Facilities on the system release schedule have installed the UHF and CDP modifications. One Facility the evaluation team visited was not even aware of these modifications. Yet the CCDs for these modifications have been closed in DOCCON.

DOCCON also does not reflect the actual status of other CCDs that remain open after the action office completed the CCD action. According to the IPT CCB Secretariats in our evaluation, action offices may not notify the Secretariat that CCD actions have been completed or respond to the Secretariat's follow up inquiries.

NAS CCB statistics in Tables 6 and 7 show that CCD actions remain open in DOCCON for extended periods of time. While certain CCD actions take years to implement due to software development and other complexities, a significant percentage of CCD actions have not been completed or closed out within three years. The evaluation team attempted to determine from DOCCON the reason why each CCD remained open. However, this information is not available in DOCCON and reviewing each NCP file would not have been completed within the timeframe of this evaluation.

Table 6 shows NAS CCB-approved open CCDs in DOCCON as of September 26, 2002. Over 35 percent of these CCDs have remained open longer than three years. Of particular concern are the 32 CCDs (almost 13 percent) that have remained open more than ten years. The oldest open CCD was issued 15 years ago. While some of these CCD actions may have been completed, they have not been closed in DOCCON. According to ACM-20, CCBs do not close CCDs until the action office confirms that CCD actions have been completed. The CCB also may withdraw a CCD through the NCP process.

Current Age of Open CCDs	Number of CCDs in Age Category	Percentage of CCDs in Age Category
Open < 1 year	80	32%
Open ≥ 1 year and < 3 years	79	32%
Open ≥ 3 years and < 5 years	17	7%
Open ≥ 5 years and < 10 years	39	16%
Open 10 years or more	32	13%
TOTAL	**247**	**100%**

Table 6- Percentage of Configuration Control Decisions by Age Category

Table 7 shows NAS CCB-approved closed CCDs in DOCCON as of September 30, 2002, including the time lapse between CCD issue date and close date. The data in Table 7 indicate a pattern similar to the data in Table 6. Over 40 percent of the closed CCDs had been open longer than three years and almost 18 percent of these CCDs had remained open longer than 10 years.

Time Between CCD Issue Date and CCD Close Date	Number of CCDs in Age Category	Percentage of CCDs in Age Category
Open < 1 year	98	38%
Open ≥ 1 year and < 3 years	53	21%
Open ≥ 3 years and < 5 years	22	9%
Open ≥ 5 years and < 10 years	37	14%
Open 10 years or more	45	18%
TOTAL	**255**	**100%**

Table 7- Percentage of Configuration Control Decisions by Processing Time Category

On October 8, 2002, ACM-20 drafted a Configuration Control Decision Action Item Closure Plan to address the NAS CCB's open CCDs in DOCCON. According to the plan, ACM-20 will conduct interim status checks on open CCD actions and document the results in a spreadsheet. ACM-20 will provide a status report at the weekly NAS CCB Operations meeting.

When action offices do not provide the actual status of CCDs in DOCCON, the FAA does not have an accurate configuration of the NAS. Configuration management stakeholders need to know the current NAS configuration when planning new acquisitions or modifications. The Logistics Center needs this information to maintain a sufficient spare parts inventory.

To assist action offices in closing out CCDs, ACM-20, AOS, AOP, and other stakeholders have been promoting the electronic transmission of modification data between MMS and the new WebCM tool. However, it appears that this capability will not be provided in the early phase of WebCM implementation.

Since the actual status of certain CCD actions is not reflected in DOCCON, Core Attributes 3 and 6 are not fully met. Configuration management is not performed over the product's lifecycle (Core Attribute 3) and changes to the NAS configuration are not recorded, tracked, and reported (Core Attribute 6) when CCDs are closed in DOCCON prematurely or not at all.

Recommendations

18. ACM-20, working in conjunction with the Airway Facilities Service, should continue to pursue electronic transmission of modification data between the Maintenance Management System and the new WebCM tool to ensure that modification status is available prior to closing Configuration Control Decisions.

19. AOS should not close Configuration Control Decision actions until Facilities have installed all applicable modifications associated with a Configuration Control Decision.

20. ACM-20, working in conjunction with the Configuration Management Core Team, should simplify the procedure for withdrawing action items in the Configuration Control Decision that are no longer feasible.

21. ACM-20, working in conjunction with the Configuration Management Core Team, should develop general guidelines for establishing completion dates for action items in the Configuration Control Decision.

22. AOS and AOP should brief the Director of Airway Facilities Service regularly on the status of open Configuration Control Decisions in the Airway Facilities Service organization.

7. FAA's Airway Facilities Service Does Not Regularly Conduct Configuration Status Audits On Deployed Systems

FAA's Airway Facilities Service does not regularly conduct configuration status audits on deployed systems to determine whether modifications have been installed and properly recorded in MMS and the FRDF. According to FAA Order 1800.66, FAA's maintenance organizations are responsible for performing detailed system audits to assess the status of modification installation. While the Regions recognize the value of configuration status audits, they maintain that they do not have the resources to conduct these audits on a routine basis. Without regularly scheduled configuration status audits to verify changes to the NAS, the FAA does not have an accurate or complete picture of the NAS configuration. The AWOS and DSR case studies demonstrate the need for configuration status audits to verify that modifications have been installed and properly recorded in MMS and the FRDF.

FAA Order 1800.66 describes several types of configuration status audits. IPT/Business Units are responsible for conducting Functional Configuration Audits (FCAs) and Physical Configuration Audits (PCAs). The purpose of these audits is to verify that the contractor has produced a system that meets the product specifications. The product baseline is established upon completion of these audits. Maintenance organizations are responsible for performing detailed system audits that assess the status of modification installation. The Order also describes Facility Space and Power Audits, as well as System Configuration/ Verification/Recovery Audits.

The Enroute Systems and Communications IPTs conducted FCAs and PCAs on DSR and ETVS, respectively. Since AWOS is a legacy system that had not been placed under the control of the Weather Systems IPT until after deployment, the evaluation team was unable to determine whether an FCA or a PCA had been conducted on AWOS.

Each Region in our evaluation has an organizational branch that conducts technical evaluations of overall NAS operations, including configuration status reviews where the evaluators determine whether Facilities have installed modifications and properly recorded this information in MMS and the FRDF. However, Regional Configuration Management Coordinators noted that there are currently fewer resources devoted to technical evaluations than several years ago. As a result, the Regions have been conducting evaluations on a more sporadic basis in recent years. In addition to Regional evaluations, AFZ-700 conducts audits of Facility drawings and activities performed by the Regional Configuration Management Coordinator.

Without regularly scheduled configuration status audits to verify changes to the NAS, the FAA does not have an accurate or complete picture of the NAS configuration. Facilities are more likely to install modifications and update MMS and the FRDF if configuration audits are routinely conducted. The AWOS and DSR case studies demonstrate the need for these audits. In one Region, the Modification Coordinator recalled a technical evaluation where one radar site had not installed nine modifications. When the evaluator contacted the other radar sites in the Region, he found that none of the radar sites had the current configuration.

Since FAA's Airway Facilities Service conducts configuration status audits on a sporadic basis, Core Attribute 7 is not fully met. The Regions need to conduct regularly scheduled audits to verify changes to the NAS.

Recommendations

23. The Regions should conduct regularly scheduled Facility configuration status audits to verify that modifications have been installed and properly recorded in the Maintenance Management System and the Facility Reference Data File.

24. The Regions should brief the Director of Airway Facilities Service regularly on the results of configuration status audits.

8. Configuration Management Training Varies Widely Among Stakeholders

The level and types of configuration management training vary widely among stakeholders in the configuration management process from periodic, informal courses to full certification. While FAA Order 1800.66 describes three levels of training (awareness, comprehension, and applied knowledge), the policy does not include details regarding the expertise stakeholders need to acquire at each level or the training resources available to gain this expertise. ACM-20 is in the process of drafting a corporate-level training plan that will address these issues. In the interim, stakeholders have had to address their training needs without the benefit of a corporate-level perspective on configuration management training in the FAA.

FAA Order 1800.66 describes three levels of training:

- The first level is awareness training for stakeholders who need general familiarity with configuration management.

- The second level is comprehension training for stakeholders who need an understanding of configuration management.

- The third level is applied knowledge training for stakeholders who need a level of understanding and capabilities that result in the skills and abilities to perform configuration management in the FAA.

While the Order describes these three levels of training, the policy does not include details regarding the expertise stakeholders need to acquire at each level or the training resources available to gain this expertise. Configuration management training varies widely among stakeholders from periodic, informal courses to full certification.

NAS-level training includes national conferences and workshops offered to all levels in the configuration management process, a Regional outreach initiative, and specialized training (e.g., DOCCON and NAS-MD-001). In addition to ACM-20's national conferences and workshops, the IPT, Operational, and Regional levels offer other training options. IPT-level training includes IPT-sponsored training conferences for the Regions, training classes at local universities, and full certification by the International Society of Configuration Management. Operational-level training includes specialized training on topics such as System Support Modifications and local documentation tracking tools like CCC Harvest. Regional-level training includes training specifically requested by the Facilities. Facility-level training options include specialized training on topics such as the FRDF.

The IPTs in our evaluation allocated more time and resources to configuration management training than the Regions or Facilities, although the level of support varied from one IPT to another. Those IPTs with a staff dedicated to configuration management activities placed more emphasis on training and had developed configuration management training plans. The Regions devoted limited time and resources to configuration management training. The Regional Configuration Management Coordinators attended ACM-20's national conferences and workshops, but they had not developed configuration management training plans. The Facilities rarely allocated time and resources to configuration management training.

ACM-20 is in the process of drafting a training plan that will provide a corporate-level perspective on configuration management training in the FAA. In the interim, stakeholders have had to address their training needs without the benefit of this perspective. The Configuration Management Core Team should

assist ACM-20 in preparing the corporate-level training plan to ensure that the training requirements for all stakeholders have been included in the plan. Stakeholders in our evaluation offered several training suggestions that should be considered by the training plan developers:

- One Facility suggested that ACM-20 offer computer-based configuration management training.
- One Region suggested that the FAA Academy provide configuration management training to technicians becoming certified on new systems or re-certified on deployed systems.
- Two Regions suggested that ACM-20 hold a configuration management conference every year.
- One IPT suggested that ACM-20 focus internal training efforts on educating users about the configuration management tools in the agency.
- A NAS-level stakeholder suggested that ACM-20 reactivate its participation in the FAA's Acquisition Management System training course.

While configuration management training is provided in the FAA, Core Attribute 8 is not fully met. ACM-20 needs to complete the draft training plan to provide a corporate-level perspective on configuration management training in the agency. The Configuration Management Core Team should assist ACM-20 in this effort to ensure that the training needs of all stakeholders are included in the plan.

Recommendations

25. ACM-20, working in conjunction with the Configuration Management Core Team, should complete the Configuration Management Training Plan, obtain CMSG endorsement of the plan, and distribute it to configuration management stakeholders throughout the agency. The training plan should include details regarding the expertise stakeholders need to acquire at each level in the configuration management process and the training resources available to gain this expertise.

26. ACM-20 should update the configuration management website to include those training opportunities identified in the Configuration Management Training Plan.

9. The FAA Does Not Have A Corporate Strategy for the Configuration Management Process

The FAA does not have a corporate configuration management strategy that includes performance goals and an implementation plan for achieving these goals. While the CMSG is comprised of an agency-wide team of senior managers that guide the development, implementation, and operation of NAS configuration management, the group has not developed a corporate strategy for the configuration management process. Without a clear, integrated strategy, FAA organizations have set their own configuration management priorities and pursued multiple, independent configuration management initiatives across the agency. Until a corporate configuration management strategy and implementation plan for reaching corporate performance goals is developed, FAA organizations will continue to set their own goals and priorities and allocate resources accordingly.

ARA-1 and ATS-1 established the CMSG in November 1998 to resolve cross-functional configuration management issues and, in conjunction with ACM-20, ensure consistent implementation and operation of configuration management across the agency. However, the last documented CMSG meeting was in March 2000. There is some evidence that a CMSG meeting occurred in March 2001, but no meeting minutes were produced. In the last few years, ACM-20 has been focusing most of its resources on procuring a national automated configuration management tool.

The CMSG's failure to provide a clear, integrated strategy has resulted in multiple, independent configuration management initiatives across the agency. The national automated configuration management tool is an example where two organizations pursued different solutions to meet the national requirement. Ultimately, ARA-1 and ATS-1 selected one tool over the other. Since selection of the configuration management tool was a cross-functional issue, the original decision to procure a single automated tool should have been supported by the CMSG. The CMSG could have identified procurement of the automated tool as a top-priority and developed a plan for achieving this goal, including stakeholder buy-in.

The CMSG is not currently providing a forum for addressing cross-functional issues. This group could be proactive in addressing the following issues discussed in this report:

- The Technical Architecture (key issue associated with Finding 1)
- Locally developed systems that are not placed under configuration control (key issue associated with Finding 2)
- The relationship between modification tracking and the change control process (key issue associated with Findings 3, 5, and 6)
- Options for improving the efficiency of the change control process (e.g., classifying proposed changes into Class I or Class II categories as discussed in Finding 4)
- Technical evaluations conducted by the Regions (key issue associated with Finding 7)
- ACM-20's draft training plan (key issue associated with Finding 8)

In addition, the CMSG could be proactive in addressing stakeholder expectations related to the new WebCM Tool. Table 8 illustrates the gap between stakeholder expectations for WebCM and the actual capabilities that the tool is expected to provide upon implementation. For example, stakeholders have expressed expectations that the first version of WebCM will replace DOCCON and allow access through their own tool suites. While these capabilities are planned for 2003 and 2004, respectively, they have not been funded yet. In addition, stakeholders have commented that WebCM will manage Facility drawings and provide performance metrics that exceed DOCCON's capabilities. However, ACM-20 has not determined at this time whether these two capabilities will be included in WebCM.

Stakeholder Expectations for WebCM	WebCM Functionality	Implementation Plan
Automate NCP process	Automated case file/ NCP/CCD processing	Initial and enhanced WebCM, both planned for FY 2003
Transfer stakeholder records to new tool	CM Web Portal provided	Program Support Library planned for FY 2003, but not yet funded
Create virtual Document Control Center	Document repository provided through CM Web Portal	CM Web Portal and virtual Document Control Center functionality planned for FY 2004, but not yet funded
Replace DOCCON	DOCCON replaced	Integration and migration planned for FY 2003, but not yet funded
Access WebCM through other tool suites	CM data transferred to WebCM from stakeholder tool suites (e.g., pb-ICE, CCC Harvest, MMS, etc.)	Interfacing and integration planned for FY 2004
Collect and report performance metrics that exceed DOCCON's capabilities	None planned at this time	To be determined in FY 2004
Manage Facility drawings	None planned at this time	To be determined in FY 2004

Table 8- WebCM Expectations and Capabilities

Since the CMSG has not developed a corporate configuration management strategy to provide direction to configuration management stakeholders, Core Attribute 2 is not fully met. The CMSG needs to offer stakeholders the opportunity to manage expectations and reach consensus on cross-functional issues. Until the CMSG develops a corporate strategy and an implementation plan for reaching performance goals, FAA organizations will continue to set their own goals and priorities and allocate resources accordingly.

Recommendations

27. The Configuration Management Steering Group should develop a corporate configuration management strategy that establishes performance goals and provides an implementation plan for achieving these goals. The corporate strategy, performance goals, and implementation plan should be updated annually and communicated to stakeholders.

28. ARA-1 and ATS-1 should re-evaluate the composition of the Configuration Management Steering Group to determine whether managers at the appropriate level are included as permanent members of the group.

29. The Configuration Management Steering Group should meet regularly to address ongoing cross-functional configuration management issues.

10. Performance Metrics Are Not Tied To Corporate-Level Performance Goals For The Configuration Management Process

While stakeholders employ various performance metrics related to the NAS change control process, these metrics are not tied to corporate-level performance goals for the FAA's configuration management process. FAA Order 1800.66 describes how stakeholders can obtain metrics from DOCCON to evaluate the effectiveness of the NAS change control process. However, similar to ARA and ATS's performance plans, outcome-oriented performance metrics should be used to evaluate the FAA's success in achieving corporate-level performance goals for the configuration management process. Since the FAA has not

developed these performance goals, stakeholders must apply performance metrics based on organizational-specific goals to evaluate the effectiveness of their configuration management activities.

FAA Order 1800.66 provides examples of NAS, IPT/Business Unit, and Regional level performance metrics that can be obtained from DOCCON to evaluate the effectiveness of the NAS change control process. At the stakeholder's request, ACM-20 can provide additional performance metrics from DOCCON. The Order does not provide examples of performance metrics at the Operational and Facility levels.

Stakeholders at the NAS, IPT, Operational, and Regional levels employ various performance metrics related to the NAS change control process. These metrics generally relate to NCP or case file processing time and CCD closure. However, some stakeholders do not use performance metrics to evaluate their configuration management activities. One IPT in our evaluation does not use metrics except to manually track NCP processing time. Two Regions we visited do not use any performance metrics related to their configuration management activities. In addition, the Regions and Facilities in our evaluation do not use performance metrics to evaluate the effectiveness of their modification processing activities.

While stakeholders should be commended for employing performance metrics based on organizational-specific goals, these metrics also need to be tied to corporate-level performance goals for the FAA's configuration management process. For example, the ARA and ATS performance plans provide high-level goals that are strategically aligned with the FAA and Department of Transportation's performance goals. ARA and ATS organizations develop their performance goals to support high-level goals. Both organizations are developing outcome-oriented metrics that will be used to evaluate their success in achieving performance goals. In the same manner, the CMSG needs to develop corporate-level performance goals for the configuration management process and establish outcome-oriented metrics that would be used to evaluate the FAA's success in achieving these goals. Stakeholders would align their organizational-specific goals with the corporate-level performance goals.

According to ACM-20, the capability to collect and report performance metrics that exceed DOCCON's capabilities has not been included in WebCM. However, stakeholders need to be able to efficiently collect and report their performance metrics before the FAA can evaluate its success in achieving corporate-level performance goals.

While stakeholders in the configuration management process are employing some performance metrics to evaluate organizational-specific goals, Core Attribute 4 is not fully met. Performance metrics need to be tied to corporate-level performance goals for the FAA's configuration management process.

Recommendations

30. After developing corporate-level performance goals, the Configuration Management Steering Group should endorse outcome-oriented performance metrics that will be used to evaluate the FAA's success in achieving these performance goals.

31. ACM-20 should ensure that stakeholders in the configuration management process have the capability needed to efficiently collect and report performance metrics to the appropriate management level.

Appendix A: Core Attributes of Effective Configuration Management

Appendix A provides detailed information for each of the eight core attributes the evaluation team used when evaluating the practices of configuration management in the FAA. The creation of these core attributes came from a thorough review of the EIA Standard 649, the Military Handbook 61, and FAA Order 1800.66. Private industry and government agencies recognize EIA Standard 649 and the Military Handbook 61 as the standards for configuration management. FAA Order 1800.66, created after the other documents, uses the same core elements of configuration management, tailored to fit the FAA. For each core attribute, the source documentation follows the description of the core attribute.

Core Attribute One: Configuration management practices result in requirements being traceable from the NAS level to the service and product levels.
Description Formal configuration management, when properly conducted, provides a document trail that allows organizations to trace requirements to the originating source. In the FAA, effective configuration management should allow service and product levels to trace product specifications back to the NAS requirements documents, SR-1000 and DD-1000. If all documents are under formal configuration control, a change to any document or product should be traceable to all levels.
Sources FAA Order 1800.66: Section 3.4.4.2 (Part II), EIA Standard 649, and Mil Handbook 61

Core Attribute Two: Configuration management strategy is established and roles and responsibilities are clearly defined and communicated.
Description The NAS level is responsible for creating a central configuration management strategy from which stakeholders can establish their roles, responsibilities, and documentation. Configuration management requires that the roles and responsibilities of each organization, group, department, or level be clearly defined and communicated through documentation. This is because configuration management relies heavily on the cooperation of various organizations. If one stakeholder does not understand his or her roles and responsibilities, the management of system configuration will likely fail.
Sources FAA Order 1800.66 (throughout document, Part II), EIA Standard 649, and Mil Handbook 61

Core Attribute Three:
Configuration management is planned and performed over the product's lifecycle.

Description
The FAA uses the Acquisition Management Lifecycle (AMS) to acquire, deploy, maintain, and decommission systems. Configuration management is a vital part of the AMS lifecycle from the management of the initial system requirements to the configuration of the system's deployed equipment. Organizations must plan and perform configuration management activities, such as modification implementation and documentation control, over the life of the product.

Sources
FAA Order 1800.66: Appendix 1, Section 4.0, EIA Standard 649, and Mil Handbook 61

Core Attribute Four:
Configuration management activities are repeatable, measurable, and flexible.

Description
Stakeholders using configuration management have varying requirements and needs. Therefore, the CM process must be flexible and repeatable. Flexibility allows organizations to tailor certain parts of configuration management to fit their needs. Repeatability requires all stakeholders to use the configuration management change process to make changes to equipment and documentation in a centralized and organized fashion.

For the process to improve, configuration management must have the ability for users to measure the process and determine inefficiencies and bottlenecks.

Sources
FAA Order 1800.66: Section 3.4.3 (Part II), EIA Standard 649, and Mil Handbook 61

Core Attribute Five:
Configuration items are uniquely identified and baselined, and the information is maintained in a repository.

Description
Configuration items separate system components into smaller, identifiable units for the purpose of managing further development. Each configuration item is documented, controlled, maintained, and audited. A configuration item can be a piece of equipment, a small part, or a document, and the unique identification of each configuration item is essential to its management. Appropriate stakeholders must baseline the configuration item so that future users will be able to review and evaluate changes, as well as track revisions and modifications.

Stakeholders must also maintain configuration item information, such as baseline documentation, in a repository for future review and changes. All relevant parties must have access to the repository either directly or by request.

Sources
FAA Order 1800.66: Section 3.3 (Part II), EIA Standard 649, and Mil Handbook 61

Core Attribute Six:
Changes to the NAS configuration are recorded, tracked, reviewed, approved, and reported.

Description
This Core Attribute defines the entire change control process in the FAA. For configuration management to be efficient and closed-loop, all steps of the change process must be complete. Originators must record or document the change before Must Evaluators can review it. Various organizations, often those impacted by the change, review the change to determine its impact on other systems or documentation before approval. The final approval authority is the Configuration Control Board (CCB), a group of stakeholders with the ability to make decisions on the technical feasibility of a proposed change. The CCB reports its approval or disapproval of the change and provides action items for tracking. The CCB and other relevant stakeholders must track the changes to ensure completion.

Sources
FAA Order 1800.66: Section 3.4 (Part II), EIA Standard 649, and Mil Handbook 61

Core Attribute Seven:
Configuration audits and inspections, including contractor configuration management activities, are conducted and documented.

Description
To ensure that stakeholders complete their action items, audits and inspections are a vital part of configuration management. When configuration audits and inspections are conducted and documented, stakeholders are more likely to complete their configuration management activities and action items, thereby closing the loop on configuration management.

Sources
FAA Order 1800.66: Section 3.4.4.3 and Section 3.5 (Part II), EIA Standard 649, and Mil Handbook 61

Core Attribute Eight:
CM training is provided.

Description
For stakeholders to effectively perform configuration management and understand their roles and responsibilities, as well as the organization's strategy, organizations need to provide training.

Sources
FAA Order 1800.66 Part I, EIA Standard 649, and Mil Handbook 61

Appendix B: NAS Configuration Management Evaluation Case Studies: Display System Replacement, Automated Weather Observation Systems, and Enhanced Terminal Voice Switch

Introduction

At the request of the Associate Administrator for Research and Acquisitions (ARA-1) and the Associate Administrator for Air Traffic Services (ATS-1), ACM-10 conducted an evaluation of the status of configuration management (CM) in the Federal Aviation Administration (FAA). ARA-1 and ATS-1 requested that the evaluation depict the current configuration management environment from the National Airspace System (NAS) level to the Facility level activities and that the team use case studies to highlight the range of configuration management activities across specific systems.

The evaluation team selected two FAA programs to serve as case studies for the evaluation based on level of maturity of their configuration management processes, the number of deployed systems, the lifecycle phase, and the locations of the systems. The programs the evaluation team selected were Display System Replacement (DSR), and Automated Weather Observation System (AWOS). The team was subsequently asked by management to include a third case study, Enhanced Terminal Voice Switch (ETVS).

Appendix Organization

This appendix describes the configuration management environment, draws conclusions about configuration management, and communicates the major issues for each of the three programs. The evaluation team organized each case study according to the different levels that handle the responsibilities of configuration management:

- Integrated Product Team (IPT) Level
- Operational level[6]
- Regional Level
- Facility Level

After evaluating industry and government standards including the Mil Handbook, EIA Standard 649, and FAA Order 1800.66 to determine configuration management characteristics, the evaluation team established the eight core attributes (described earlier in the report) that describe effective configuration management. The Evaluation Team used the core attributes of configuration management to organize the data in this appendix and to assist in developing conclusions for the report.

Display System Replacement Case Study

The evaluation team selected DSR for one of its three case studies based on the maturity of its process improvement. The DSR product team reached integrated Capability Maturity Model (iCMM) Level 3 in 2002, making it one of only three product teams in pursuit of iCMM Level 3 at the start of the evaluation. When selecting DSR for the case study, the evaluation team also considered the number of deployed systems, the lifecycle phase, and the locations of the systems.

Throughout the data collection phase of the evaluation, the team worked with numerous stakeholders, all of whom provided candid responses and useful recommendations on the configuration management process for DSR. Those stakeholders included the Integrated Product Team (IPT) for En Route Systems (AUA-200), National En Route Automation Division (AOS-350), Southern Region (ASO), Western-Pacific Region (AWP), and Eastern Region (AEA). The team also visited five Facilities that were listed

6 *Operational organizations include AOS, AOP, AML, ANI, and AFZ.*

in Maintenance Management System (MMS) as having DSR installed. The evaluation team chose the Facilities based on their proximity to Washington, D.C. or to the three Regional Offices visited.

Display System Replacement Background

Display System Replacement is a system built to modernize Air Route Traffic Control Center (ARTCC) equipment by replacing the display channels in controller workstations. DSR receives data from numerous systems and displays that information in a controller-friendly format in 20 ARTCCs. DSR is fully deployed and as such, is in the 'in service management' phase of the Acquisition Management System (AMS) lifecycle.

En Route Integrated Product Team Level Configuration Management Practices

AUA-200, the En Route IPT, is the organization responsible for the solution implementation (SI) of DSR. The En Route IPT created the product specifications and baselined the system as a configuration item under the En Route IPT Configuration Control Board (CCB). AUA-200 also processes and adjudicates changes to the DSR baseline.

En Route Integrated Product Team Configuration Control Board

The En Route IPT CCB processes NAS Change Proposals (NCPs) that stakeholders review and recommend for adjudication. The En Route IPT CCB elevates changes to the NAS CCB when the proposed change affects a system interface. The En Route IPT CCB meets once per month, even if there are no changes to process, to ensure consistency in the scheduling of meetings and promote stakeholder attendance. However, the CCB does not hold pending NCPs until the next monthly meeting. Case files are often processed and adjudicated before the CCB meeting to avoid processing delays. Once the required documentation is complete, the CCB submits documentation to the Documentation Control Center (DCC) through ACM-20. The required documentation includes case file copies, CCB minutes, CCB agendas, and Configuration Control Decisions (CCDs).

The Executive Secretariat ensures that all information presented at the CCB meeting is addressed and discussed at a pre-briefing. The pre-briefing ensures that all items on the agenda are ready for final adjudication.

En Route Integrated Product Team Configuration Management Process

AUA-200 processes case files that alter the configuration of the system. These case files enter the configuration management process as change requests. The procedure for processing a change request varies depending on the originator. Changes can originate from the field, AOS, the IPT, or Headquarters. Figure B.1 describes the procedure used to process change requests. Note that the organization responsible for originating the change is shown in a gray box.

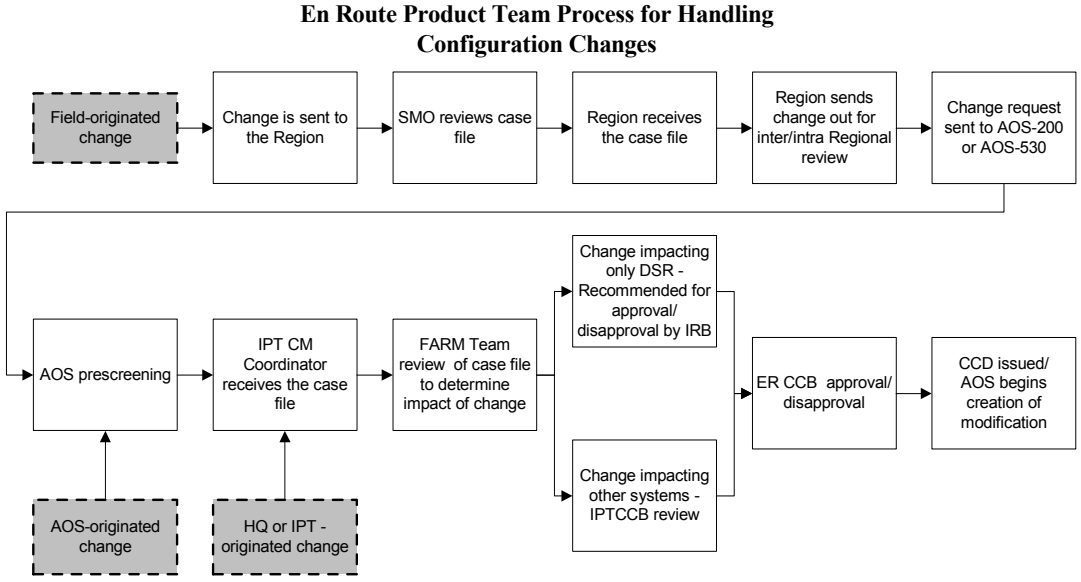

Figure B.1

To monitor the progress of a change request through the configuration management process, AUA-200 uses an Access database. The tool provides information including, but not limited to,

- Open and Closed NAS Change Proposals (NCPs),
- Open and Closed CCDs,
- Amount of time to process NCPs,
- Amount of time to close CCDs, and
- Comment resolution information.

The database allows AUA-200 to report metrics on configuration management processes and practices, as well as track relevant status accounting information.

Operational Level Responsibilities

AOS-300 provides second level engineering support for systems in the National En Route Automation Division, and AOS-350 handles second level engineering support for DSR. As part of that support, AOS-350 reviews change requests and receives decisions from CCDs adjudicated at the En Route CCB. AOS also receives change requests from the field for prescreening, including Program Trouble Reports (PTRs) and Hardware Discrepancy Reports (HDRs), and provides system modifications for change requests and case files.

AOS originates the majority of the changes for DSR, with field input, because AOS does not permit local software changes or adaptations for DSR systems. AOS receives and prioritizes all change requests that originate in the field and AOS. Each change request is sent through the prescreening and review teams, described in the section below, to determine the type of change, the level of effort required to process the change, and the modification necessary to fix the problem. AOS receives notification from the IPT after the CCB has adjudicated the case file, and engineers receive action items to produce a modification.

- AOS-350 has implemented the following mechanisms to help the engineers maintain DSR modification installation information.

- AOS-350 conducts monthly teleconferences with all of the DSR sites. During those teleconferences, technicians are able to discuss problems with the software or hardware and keep updated on the latest modifications.
- AOS-350 publishes meeting minutes so that the sites are able to read about the monthly teleconferences if technicians are unable to attend.
- AOS-350 maintains and staffs a DSR help desk for troubleshooting. The help desk maintains a list of the current system configurations, as well as looking for any trends in reported problems. Those trends can point to the need for a PTR, HDR, or NCP.
- AOS also maintains a product support library from which users and stakeholders can obtain essential information.
- AOS-350 tracks the software versions at the various DSR sites on a 'white board'.

The evaluation team attempted to verify whether AOS records of current DSR configurations matched facility records at the sites we visited. However, the team was unable to perform this task because AOS did not provide a listing of current configurations for DSR at all sites. Therefore, it is not clear whether AOS maintains accurate information about DSR configurations.

Interface between AUA-200 and AOS-350: Review and Prescreening Teams

AUA-200 interfaces with AOS-350 through configuration management teams, where AUA-200 works with AOS to ensure that changes are technically feasible before adjudication. To assist in handling changes, AUA-200 and AOS-350 have created a unique set of prescreening and review bodies, not seen in the other IPTs the evaluation team interviewed. In the following groups, AOS representatives serve as co-chairs.

- *Fielded Automation Requirements Management Team (FARM Team)* – The FARM Team is responsible for prescreening those changes that AOS review teams deem appropriate for the NCP process. The FARM Team handles any changes that affect interfaces or alter the product baseline. The FARM Team provides change packages and prescreening services to the En Route CCB for Engineering Changes (EC's) and external product interfaces.
- *In Service Management Team (ISMT)* – The ISMT forms once the IPT establishes the product baseline and the operational baseline. The ISMT is responsible for consolidating the comments and recommendations of the other prescreening boards to monitor and manage the product's baseline.
- *Integrated Resolution Board (IRB)* – The IRB is responsible for generating and/or approving change requests, waivers, deviations, and other configuration requests for DSR. The IRB also is responsible for prescreening NCPs and preparing CCD action items for the En Route CCB. The primary function of this board is to handle all changes that affect the DSR program (no impact to interfacing systems) without elevating the case file to the En Route CCB.

AOS-350 assists in chairing several groups that conduct prescreening and handle lower level changes such as PTRs and HDRs. These groups, described in detail below, are primarily engineering boards that send findings and recommendations to the IPT-level groups.

- *Engineering Scrub* – The primary responsibility of the Engineering Scrub is to determine if site issues are within the scope of the system specification and identify any previously addressed PTRs or HDRs.
- *Engineering CCB* (ECCB) – The Engineering CCB is comprised of several other boards that propose changes for Engineering CCB review and approval.
- The *Software CCB* is responsible for reviewing and approving all technical changes to a program. It forwards its decisions and recommendations to the Change Approval and Packaging Board (CAPB) for review.

- The *CAPB* or *Change Approval and Packaging Board*, controls the decision-making on all changes made to the cost, schedule, baseline and implementation plans. The CAPB reviews and approves changes before they are sent to the Program CCB (PCCB).
- The *Program CCB* receives changes that the Software CCB and the CAPB have reviewed. The PCCB approves of the change before its formal adjudication at the ECCB and its final Problem System Analysis Team (PSAT) and IRB review.

Other Boards that review changes prior to the IRB meeting include the following:

- *Program Review Board (PRB)* - responsible for prioritizing and categorizing PTRs and baseline releases prior to the IRB
- *Problem System Analysis Team (PSAT)* - responsible for reviewing Discrepancy Reports (DRs) and providing recommendations to the IRB. The PSAT receives information from the Engineering Scrub or the Air Traffic System Requirements Service (ARS).
- *Change Request Meeting (CR PSAT)* - provides a technical forum for discussing CRs, which are reviewed for technical accuracy, cost, schedule, resources, and training. The CR PSAT forwards its recommendations to the IRB for approval.

The following chart describes the process the presecreening and review teams use to review changes:

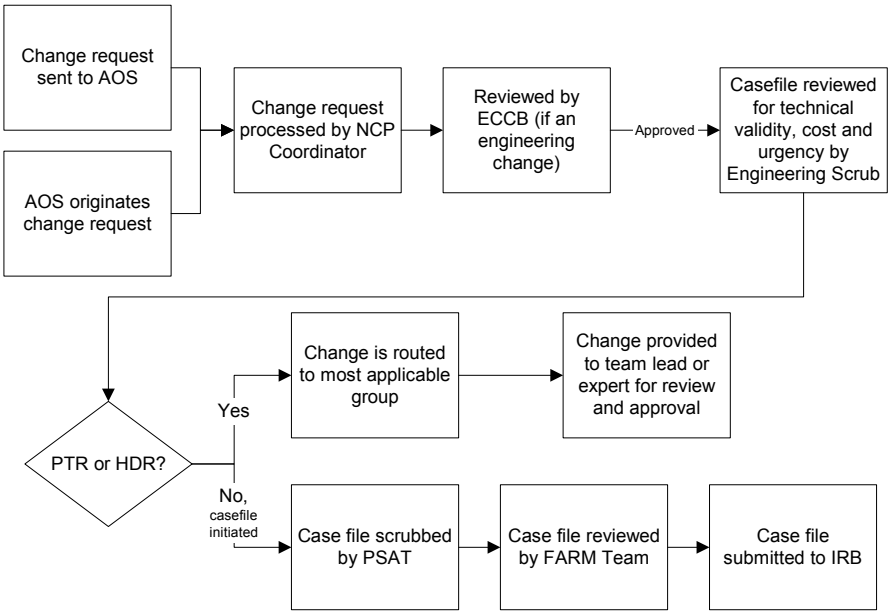

Figure B.2

Regional and Facility Level Responsibilities

The Regional configuration management activities include Regional configuration management coordination and Regional CCB activities. At FAA Facilities, configuration management includes the implementation of modifications, maintenance of system documentation, and record updates.

Regional Configuration Management Coordinator

The Regional CM Coordinator is responsible for the configuration management process for the Region. The functions of the Regional Coordinator fall into three categories.

- The Regional CM Coordinator may be the Executive Secretariat of the Regional CCB *(2 of 3 Regions)*.[7] The Secretariat routes configuration management information and provides administrative services such as pre-briefings to CCB chairpersons.
- The CM Coordinator handles NCPs, ensures proper adjudication, processes information, updates stakeholders, and completes action items.
- The CM Coordinator also ensures that Sector Management Office (SMO) managers conduct Facility baselining and perform updates to those baselines. Although Facility baselining is just one of the many responsibilities of the CM Coordinator, it is a continuous and lengthy process, and the final Facility drawings are essential to maintaining the site data for future system implementation.

Modification Coordinators

Sites are responsible for reporting their modifications, and Regions are responsible for tracking implementation. The evaluation team learned through Regional interviews and discussions that modifications are often handled outside of the configuration management process. Modifications and configuration management activities were handled separately in two of three Regions.

Facility Configuration Management

The DSR technician's primary function is to maintain the system. A vital part of that maintenance is the implementation of modifications. A part of the modification process is the maintenance of modification documentation to include the Facility Reference Data File (FRDF) and MMS. Technicians are to use these records to document the status of modification receipt and implementation.

Modifications are implemented, but they are not always implemented immediately. The technicians have six months to implement a modification, but modification implementation does not always occur within six months due to system outage issues or resources. DSR systems need to be operational twenty-four hours per day, making it difficult to service the system. When technicians service the equipment, they must work overnight.

Once the modification is received, the technician is responsible for maintaining documentation of receipt and implementation in both hard copy (FRDF) and electronically (MMS). When the modification is implemented, the technician is responsible for closing out modification information in MMS and manually submitting modification paperwork, as well as updating the FRDF. However, some technicians for DSR did not understand the need for other organizations to know their DSR system's configuration. When reviewing the DSR FRDFs and MMS records, the evaluation team found that technicians were not consistently updating their records.

[7] *In one Region, contractors handled the majority of CM Coordination, with some participation from the Executive Secretariat.*

	Center One	Center Two	Center Three	Center Four	Center Five
Total Relevant Modifications[8]	47	30	48	46	47
Number of modification records in the FRDF	18	30	1	38	3
Number of modification records in MMS	9	28	7	31	1
Number of modifications where FRDF records **match** MMS records[9]	5	28	1	30	1
Number of modifications where FRDF records **do not** match MMS records[10]	16	2	6	8	2
Number of modifications that do not contain information in either MMS or the FRDF[11]	26	0	41	9	44

Figure B.3

- FRDF records are incomplete in most DSR Facilities
  - Three of five Centers have less than 40% of their relevant modifications listed in the FRDF with the implementation status. Two of these three have 6% or less of the relevant modifications listed in the FRDF (1 of 48 modifications for one Center and 3 of 47 modifications for the other Center).
- MMS records are incomplete
  - Three of five centers have less than 20% of their relevant modifications in MMS. One of those centers has only 2% (1 of 47) of its modifications recorded in MMS.
- MMS and FRDF records do not match
  - In three centers, over 55% of the modification records relevant for the site had no information in either the FRDF or MMS. Two of these three centers had no information in their FRDF or in MMS for over 85% of their relevant modifications.
- Two of five Centers maintained their FRDF files and MMS records
  - Both Centers had over 80% of their relevant modifications in the FRDF, with one Center recording 100% of its modifications.
  - Both Centers had over 65% of their modifications logged correctly into both the FRDF and MMS (30 of 46 and 28 of 30, respectively).

The evaluation team attempted to determine if AOS records matched the FRDF and MMS records. However, we were unable to determine if AOS records referred to DSR's application system or operating system because AOS-350 did not provide such information. Therefore, we were not able to include AOS-350 information in Figure B.3.

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8 *Relevant modifications include modifications that were not cancelled or designated for a specific site (SSM-DSR-023 only relevant for one Center). This also **does not include** modifications listed in the FRDF as not applicable to the equipment. We included SSM-DSR-001 through SSM-DSR-054.*

9 *Both MMS and the FRDF records show the modification status as installed or not installed*

10 *Two scenarios may cause the records to not match. First, MMS and the FRDF show a different implementation status. Second, the FRDF shows the modification as implemented/not implemented while MMS does not have information on that modification (and vice versa)*

11 *Neither the FRDF nor MMS have any record of the modification*

Conclusions

Core Attribute One: Configuration management practices result in requirements being traceable from the NAS level to the service and product levels.	***Expectations:*** ▪ The IPT is responsible for assisting Air Traffic System Requirement Service (ARS) in tracing all decomposed system and subsystem requirements through the acquisition documentation to the contractor/vendor-generated documentation. This includes the establishment of a Traceability Matrix. The Product Team (PT) translates high-level system requirements from the final Requirements Document (fRD) to a system level document that includes system, performance, detailed, and general specifications. ***Conclusions:*** ▪ AUA-200 works with the contractor to develop the requirements traceability matrix, tracking all system and subsystem requirements back to the specifications. AUA-200 maintains the matrix as part of its systems engineering function.
Core Attribute Two: Configuration management strategy is established and roles and responsibilities are clearly defined and communicated.	***Expectations:*** ▪ FAA Order 1800.66 outlines the responsibilities for defining configuration management strategy and establishing roles and responsibilities at each level. AUA-200 and Regional CM Coordinators place their CM strategies in their CM Plans. FAA Orders and other documentation communicate roles and responsibilities to the IPT, AOS, Regions, and Facilities. ***Conclusions:*** ▪ AUA-200 has a CM strategy incorporated into the IPT CM Plan. ▪ AUA-200 is performing according to its clearly defined and communicated roles and responsibilities. AUA-200 has defined roles and responsibilities through its CM Plan, CM Operating Procedures, CCB Charter, and other Boards that assist with the configuration management process. AUA-200 wrote these documents based on FAA Order 1800.66. ▪ AOS-350's roles and responsibilities are clearly communicated in FAA Order 6032.1B and FAA Order 1800.66. ▪ Regions do not have a CM strategy and do not have a CM Plan that lays out the roles and responsibilities of the Regions and Facilities. Regional CM Coordinators responsibilities are documented at a high level in FAA Order 1800.66. ▪ DSR technicians do not have clearly defined and communicated roles and responsibilities, as was evident based on conflicting information regarding the implementation and tracking of modifications.

Core Attribute Two (continued)	***Issues:*** ▪ DSR technicians need further guidance on their roles and responsibilities for configuration management. The inconsistent updating of MMS and the FRDF demonstrated that the role of CM in the Facility is unclear. In addition, one technician's question inquiring why anyone would need to know the Facility's configuration demonstrates a lack of clearly defined and communicated CM roles and responsibilities.
Core Attribute Three: CM is planned and performed over the product's lifecycle	***Expectations:*** ▪ IPTs, AOS, and the Regions are responsible for configuration management planning, usually articulated through documentation and communication. All levels are responsible for configuration management performance.
	Conclusions: ▪ AUA-200 plans and performs configuration management for DSR throughout the product lifecycle. Documentation, review boards, collaboration, communication, and the transition of work to second level engineers at AOS-350 during in service management are evidence of a well planned and managed system. ▪ AOS-350 performs configuration management for DSR using prescreening Boards, teleconferences, and other processes to ensure engineers properly perform configuration management activities. ▪ In terms of performing configuration management activities on the system, the field has demonstrated varying efforts, as shown in DSR modification records.
	Issues: ▪ DSR technicians do not seem to understand and perform their configuration management activities over the product's lifecycle on a consistent basis. Facilities struggle to plan modification implementation because of all the other responsibilities at the Facility level.
Core Attribute Four: Configuration management activities are repeatable, measurable, and flexible.	***Expectations:*** ▪ The flexibility of configuration management activities allows organizations to tailor the process, within defined guidelines, to fit their needs. ▪ CM activities and processes are well documented and clearly stated. ▪ FAA Order 1800.66 states that organizations are responsible for using metrics to analyze and report the effectiveness of their CM activities.

Core Attribute Four (continued)	***Conclusions:***
	▪ At the IPT and AOS levels, configuration management activities are repeatable because AUA-200 and AOS-350 have documented CM activities in CM Plans, Operating Procedures, and other documentation. At the Regional and Facility levels, activities are less well documented. ▪ At the Facility level, CM activities are not repeatable, since the process is not documented and DSR technicians are unaware of their responsibilities. ▪ AUA-200 and AOS-350 have flexibility in their configuration management practices. The various review boards and prescreening boards that AOS-350 and AUA-200 use to review and adjudicate the changes demonstrate flexibility. ▪ AUA-200 maintains basic metrics on their CM practices, which they track and report. The IPT collects metrics on the number of Open and Closed CCDs, NCPs, and the processing time for NCPs.
	Issues:
	▪ The IPT, AOS, and Regional levels each collect different metrics to suit organizational needs. There is no overall plan that drives the collection of metrics in the IPT, AOS, or Regions. Of the metrics that these organizations collect, most are focused on improving processing time and identifying bottlenecks in the configuration management review process.
Core Attribute Five: Configuration items are uniquely identified and baselined, and the information is maintained in a repository.	***Expectations:***
	▪ The IPT develops and selects the program's lower level configuration items and lists these in the CCB Charter. IPTs create and maintain baselines for configuration items and maintain a repository for information regarding configuration items, known as a program support library. ▪ FAA Order 1800.66 states that the program support libraries for the IPTs, solution providers, and Regions will include technical baseline documents, guidance documents (plans, orders, etc.), and change vehicles.
	Conclusions:
	▪ AUA-200 baselines all configuration items at the national level. The system vendor uniquely identifies configuration items at the national level during the baselining process. The evaluation team did not inquire about the unique identification of individual pieces of equipment. ▪ AUA-200 maintains three document repositories for product support documentation. Those repositories include the Document Control Center, the En Route Library, and the AOS/ACT library. The AOS/ACT library is under the control of AOS at the Technical Center. ▪ AOS-530 ensures that the DSR documentation is submitted to the library. AOS-530 maintains most of this information in softcopy. AUA-200 maintains its baseline documentation at its intranet site.

Core Attribute Six: Changes to NAS configuration are recorded, tracked, reviewed, approved, and reported.	***Expectations:*** ▪ The handling of changes to NAS configuration is an involved and lengthy process. Each level is responsible for accomplishing a number of configuration management tasks during the change process. Without each level working together to ensure the recording, tracking, reviewing, approving, and reporting of NAS changes, problems may arise. ***Conclusions:*** ▪ AUA-200 records, reviews, approves, reports, and tracks NAS Changes through the En Route IPT CCB, FARM Team, IRB, ISMT, and other groups. AUA-200 also ensures that the En Route IPT CCB Chairperson has information regarding the recording, reviewing, reporting, and tracking of NCPs to ensure timely adjudication. ▪ AOS-350 records, reviews, approves, and reports changes. AOS-350 uses prescreening boards described in the case study to review and approve changes. AOS-350 is a Must Evaluator for all changes that occur for DSR. ***Issues:*** ▪ The team could not determine if AOS-350 adequately tracks the status of modifications at each site, because AOS did not provide a list of configuration data for each DSR Site. ▪ Facilities do not consistently report or track changes to DSR. Some Facilities do not update MMS, while others do not update the FRDF. Technicians' lack of modification implementation reporting and tracking is described in the section titled "Facility Configuration Management." ▪ The En Route IPT CCB does not always close CCDs in a timely manner.
Core Attribute Seven: Configuration audits and inspections, including contractor configuration management activities, are conducted and documented	***Expectations:*** ▪ During configuration audits and inspections, the IPTs' responsibilities include: ▪ Providing and storing information on NAS system development and deployment; ensuring that developing contractors provide and store Configuration Status Accounting (CSA) data ▪ Assembling the audit team ▪ Conducting the Functional Configuration Audit (FCA) and Physical Configuration Audit (PCA) ***Conclusions:*** ▪ AUA-200 completed a FCA and a PCA for each DSR site before establishing the product baseline. Although FCAs and PCAs are not necessary for each site (usually one is conducted for the entire system), AUA-200 wanted to ensure that the system would operate correctly at each location. ▪ AOS-350 tracks the status of DSR systems through the Help Desk. Otherwise, AOS-350 does not conduct audits for DSR.

Core Attribute Eight:	*Expectations:*
Configuration Management training is provided	▪ FAA Order 1800.66 addresses CM training at three levels: CM awareness (general familiarity with CM), CM comprehension (an understanding of CM), and Applied Knowledge (a level of CM understanding and capabilities that results in the skills and abilities to perform CM in the FAA).
	Conclusions:
	▪ AUA-200 CM staff consists of certified CM practitioners that primarily use external development and training courses to improve their CM knowledge and skills.
	Issues:
	▪ Technicians do not participate in CM training for DSR when becoming certified to work on the system or at the Facility. Configuration management is not part of system certification at the FAA Academy in Oklahoma City.

Automated Weather Observing System Case Study

The ACM-10 evaluation team selected AWOS for one of its three case studies because the AWOS product team had not pursued iCMM for process improvement. Because AWOS was not the only product at iCMM Level 0, the evaluation team chose a random sample of similar programs and contacted the respective product teams for configuration management-related documentation. The AWOS product team was unable to provide configuration management documentation and information for the system. When selecting AWOS for the case study, the evaluation team also considered the number of deployed systems, the lifecycle phase, and the location of the systems.

The evaluation team interviewed individuals from the following organizations, who provided candid responses and useful ideas and recommendations on the configuration management process for AWOS. Those organizations included the IPT for Weather Systems (AUA-400), the National Airway Systems Engineering Division (AOS-250), ASO, AWP, and AEA. The team also visited six Facilities listed in MMS as having AWOS installed[12]. The evaluation team chose those Facilities based on their proximity to Washington, D.C. or to the three Regional Offices visited.

Automated Weather Observing System Background

AWOS is a suite of weather sensors that measure and collect weather data and report such information to pilots, air traffic controllers, and other users. The sensors measure wind speed, temperature, wind direction, dew point, visibility, precipitation, cloud height, and barometric pressure. AWOS began deployment in 1988. Automated Sensor Observing System (ASOS) was to replace all 200 AWOS systems within five years. During that time, the FAA created AUA-400. Since the FAA had already procured and deployed AWOS, the FAA placed the system under the AUA-400 IPT as a configuration item. When the AUA-400 IPT first received AWOS, the contractor was maintaining the configuration

[12] *Because one Facility had two AWOS installed, we have records for seven AWOS.*

management of the system, as required under contract. As the maintenance costs began to rise, the FAA decided to take over the maintenance of AWOS.

When the National Airway Systems Engineering Division (AOS-250) took over the system during the in-service management phase, the engineers faced several challenges. The contractor had not maintained adequate system documentation, and AOS-250 never received the product specification documentation from the contractor. The system lacked a baseline, and the contractor failed to list the modifications that coincided with the specific sites. AOS-250 continues to reconcile the AWOS systems on a site-by-site basis in order to establish a reliable baseline.

Weather Integrated Product Team Level Configuration Management Practices

AUA-400 is the organization responsible for the AWOS system. Because AWOS came under the control of AUA-400 after deployment, the IPT has had limited responsibilities in handling the system's configuration management.

Weather Integrated Product Team Configuration Control Board

The Weather IPT CCB processes NCPs that stakeholders review and recommend for adjudication. The Weather IPT CCB elevates changes to the NAS CCB when the proposed change affects a system interface. The Weather IPT CCB has processed few changes for AWOS. In the past several years, only two changes (Central Data Platform (CDP) and Ultra High Frequency Radio (UHF)) have resulted in modifications and required approval from the IPT CCB. New weather systems use more of the Weather IPT CCB's resources.

Weather Integrated Product Team Configuration Management Process

The Weather IPT has not been highly involved in the configuration management of AWOS. As discussed in the Introduction section, the FAA procured and deployed AWOS before AUA-400 came into existence. The contractor managed the configuration management of the system until the FAA determined that, to reduce costs, it would take over system maintenance. At that point, the contractor had fully deployed AWOS and transferred it to AOS-250 for operational maintenance and support.

AUA-400 processes and approves case files that alter the baseline of the AWOS system. Over the past two years, AUA-400 has processed two NCPs for AWOS, each resulting in a modification. Because AWOS is a legacy system largely managed and maintained in AOS-250 and previously handled by the contractor, the evaluation team realized that AUA-400 did not have much data on the configuration management practices of AWOS. Therefore, the team focused on the general practices of AUA-400's configuration management process during interviews with AUA-400 configuration management staff.

Operational Level Responsibilities

AOS-250 is the organization responsible for the maintenance of AWOS and other weather products. AOS-250 reviews NCPs and receives decisions from CCDs adjudicated at the IPT level. AOS-250 has the authority to handle lower level changes, but it does not do so through formal lower level boards as are used in AOS-350.

AOS-250 engineers described the change process shown in Figure B.4 below. Any employee has the authority to originate a change request, including technicians and AOS engineers. The process changes slightly when other stakeholders originate changes. Local changes, however, are filtered through AOS for prescreening and review.

Change Process as articulated by AOS-250

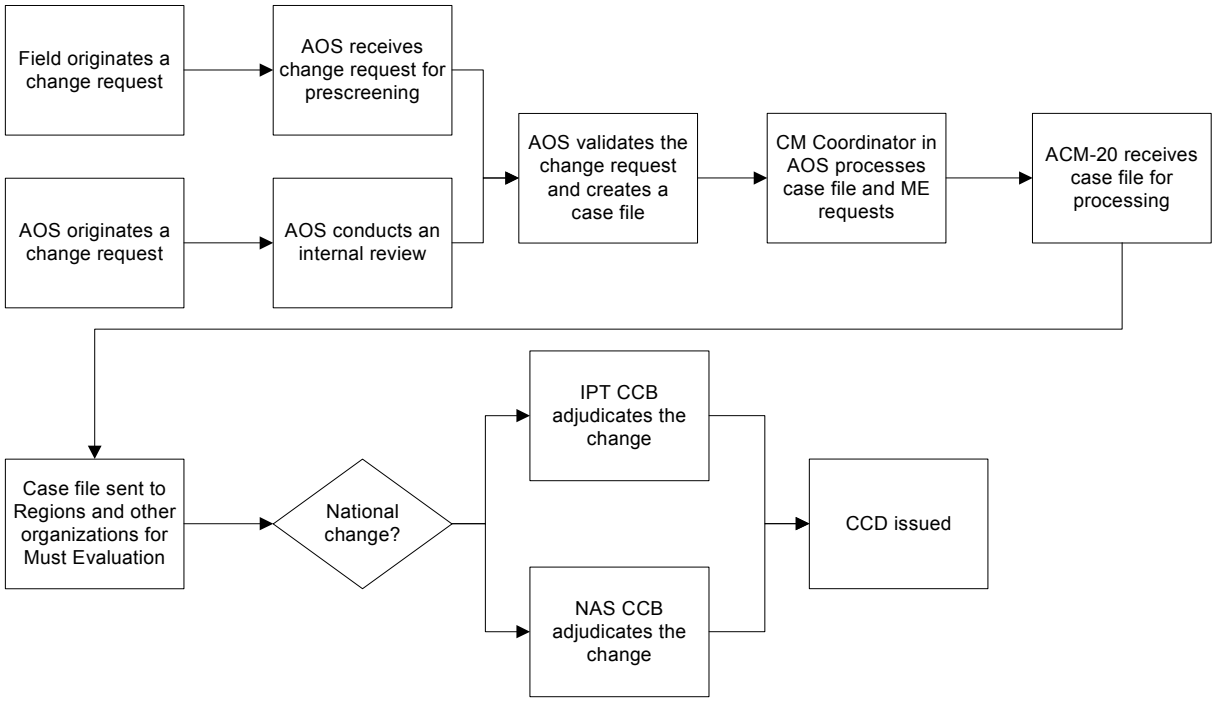

Figure B.4

Configuration management for AWOS has been particularly difficult for AOS-250. Most of the configuration management information for the system, to include documentation and code, resided with the contractor. The information provided to the FAA from the contractor was limited, as the contractor did not maintain strict configuration management practices when producing, deploying, and managing the system.

AOS-250 never received a baselined system, which made system maintenance more difficult knowing the current configuration of a system is vital in the production of new modifications. Because AOS-250 did not have the current configuration of all its AWOS systems, engineers called each AWOS site to determine the system configuration. AOS currently maintains configuration status through telephone calls because MMS does not provide the reliability that AOS-250 needs to make informed decisions on site-specific data.

AOS-250 maintains version control by using the AOS-200 CCC Harvest database and an Access database. Harvest improves the workflow process and serves as a document repository for AOS. These tools assist AOS-250 in maintaining metrics on their configuration management activities. Those metrics include CCD processing information, NCP processing information and project information.

Regional and Facility Level Responsibilities

The Regional and Facility levels have varying roles, responsibilities, and perceptions regarding configuration management activities. The Regional configuration management activities include Regional CM coordination, as well as the Regional CCB activities. At FAA Facilities, configuration management includes implementation of modifications, maintenance of system documentation and updating of records.

Regional Configuration Management Coordinator

The Regional CM Coordinator responsibilities remain the same regardless of the program discussed. Please see the DSR Case Study (page B-5) for information on Regional CM Coordinator responsibilities.

Regional Modification Coordinators

The Regional Modification Coordinator responsibilities remain the same regardless of the program discussed. Please see the DSR Case Study (page B-6) for information on Regional Modification Coordinator responsibilities.

Facility Configuration Management

The primary function of the Facility is to maintain the system. A vital part of that maintenance is the implementation of modifications. As part of modification implementation, the Facility is responsible for the maintenance of modification documentation to include the FRDF and MMS.

When AOS releases an AWOS modification, Facilities are notified of the modification and order the materials to complete the modification. There are several sources for notification. The primary source of information is that the applicable System Support Center (SSC) should receive a notice of a modification through the mail from AOS-250. The SSC then distributes the modification to the appropriate technicians. The SMO and the SSC can also use AF Tech Net, NAS Operations Teleconferences, and maintenance alerts to learn of new modifications. In addition, as of June 2002, AOS-250 opens the Log Equipment Modification (LEM) entry in MMS for each applicable Facility. The technician and the SSC manager can log onto MMS and review the modification information.

One problem that AOS faces when notifying applicable AWOS sites of new modifications is that the Facility Service and Equipment Profile (FSEP) and the AOS-250 AWOS site listings do not match. The evaluation team found two Facilities listed as AWOS sites in the FSEP that did not have AWOS equipment, according to AOS-250.

Despite the varying sources of modification data, technicians at the majority of the Facilities we visited seemed confused about modification status information and reluctant to use sources such as the intranet. One Facility was unaware of both AWOS modifications before the evaluation team announced its visit. Although there are multiple sources that provide modification information, two of the six AWOS Facilities stated that there is no way of knowing about new modifications except from other sites within the SMO because there is not a single, reliable, updated source for modification status information.

Upon receipt of a modification, technicians are responsible for completing the modification, updating the FRDF, and closing the LEM entry in MMS. Some technicians did not seem aware of the importance of installing modifications and reporting their installation.

MMS provides codes so that technicians are able to communicate delays in implementation. Using the MMS codes, technicians are able to relay modification installation information to relevant parties, such as the SMO manager. For example, technicians are able to reflect any delays in implementation due to a lost part or inadequate resources. The 180-day implementation period stops once the technician updates MMS with Facility delay information. Therefore, every Facility, whether the modification is installed or not, should report the status of the modification in MMS.

The table below shows the implementation records for recent AWOS modifications from AOS-250, site FRDFs, and MMS records.

Location	AOS Latest Modification	AOS-Recorded Status UHF Mod	UHF Installed at Site (from FRDF)?	MMS Records Reflect Installation?	AOS-Recorded Status – CDP Mod	CDP Installed at site (from FRDF)?	MMS Records Reflect Installation?
Facility 1	UHF, CDP	Installed	Yes	Yes	Installed	Yes	Yes
Facility 2	UHF, CDP	Not installed	No	Not listed	Installed	Site never provided information	Yes
Facility 3	UHF, CDP	Not installed	Cannot be installed	Not listed	Installed	Yes	Yes
Facility 4	UHF, CDP	Not installed	No	No	Not installed	No	No
Facility 5	UHF, CDP	Not installed	No	Not listed	Not installed	No	Not listed
Facility 6	CDP	Not installed	Cannot be installed	Not listed	Installed	Yes	Yes
Facility 7[13]	None	None	N/A	N/A	None	N/A	N/A

KEY

- UHF = Ultra High Frequency Radio modification
- CDP = Central Data Platform modification
- Not listed = no information in MMS for this modification and site
- N/A or None = see paragraph below
- Cannot be installed = the modification is not applicable for this site
- Site never provided information = the evaluation team never received the paperwork

Figure B.5

As Figure B.5 indicates, AWOS had two modifications in the last several years: an Ultra High Frequency (UHF) Radio modification and a Central Data Platform (CDP) modification. AOS' modification tracking data for both modifications matched the FRDF at all seven AWOS sites. However, the Facilities had not updated MMS as follows:

Of the four AWOS sites that were to install the UHF modification, only one site had updated MMS with the implementation status. The remaining three sites had not installed the modification and did not update MMS with this information.
Of the six AWOS sites that were to install the CDP modification, four of the six sites had updated MMS with the implementation status. The remaining two sites had not installed the modification and did not update MMS with this information.

13 *This AWOS is not under formal NAS configuration management. Technicians maintain the AWOS system, but the system is not listed in the FSEP, baselined in the NAS, nor does it receive AOS support. A different contractor produced this AWOS system, so the Region is not able to use the same modifications as the other AWOS systems.*

Conclusions

Core Attribute One: Configuration management practices result in requirements being traceable from the NAS level to the service and product levels.	***Expectations:*** ▪ The IPT is responsible for assisting ARS in tracing all decomposed system and subsystem requirements through the acquisition documentation to the contractor/vendor-generated documentation. This includes the establishment of a Traceability Matrix. The PT translates high-level system requirements from the fRD to a system level document that includes system, performance, detailed, and general specifications. ***Conclusions:*** ▪ AUA-400 stated that CM begins for most systems (not AWOS) at the beginning of the program, immediately after the Joint Resources Council (JRC) makes its Investment Analysis decision. For new systems, AUA-400 must assist in tracing requirements back to the Mission Need Statement (MNS) before JRC approval. ▪ AUA-400 does not trace requirements for AWOS because it is a legacy system and the FAA does not own requirements documentation for AWOS. ***Issues:*** ▪ When a contractor develops a system and handles the configuration management, the IPT is responsible for ensuring that the proper documentation and configuration management activities occur. In the case of AWOS, the FAA did not closely monitor the configuration management, which resulted in a lack of the documentation necessary to maintain effective configuration management.
Core Attribute Two: Configuration management strategy is established and roles and responsibilities are clearly defined and communicated.	***Expectations:*** ▪ FAA Order 1800.66 outlines the responsibilities for defining configuration management strategy and establishing roles and responsibilities at each level. AUA-400 and Regional CM Coordinators place their CM strategies in their CM Plans. FAA Orders and other documentation communicate roles and responsibilities to the IPT, AOS, Regions, and Facilities. ***Conclusions:*** ▪ AUA-400 follows FAA Order 1800.66, developing CM Plans and other documentation based on the guidance in the Order. ▪ AUA-400 and AOS-250 have clearly defined and communicated roles and responsibilities. ▪ Regions do not have a CM strategy and do not have a CM Plan that lays out the roles and responsibilities of the Regions and Facilities. Regional CM Coordinators responsibilities are documented at a high level in FAA Order 1800.66. ▪ AWOS technicians did not appear to fully understand their roles and responsibilities, particularly with regard to modification tracking.

Core Attribute Two (continued)	***Issues:***
	▪ Many AWOS technicians, SSC managers, and SMO managers requested that AOS create documentation relaying all of the field's responsibilities in configuration management. In many cases, the field does not view their responsibilities as being part of configuration management.
Core Attribute Three:	***Expectations:***
CM is planned and performed over the product's lifecycle	▪ IPTs, AOS, and the Regions are responsible for configuration management planning, usually articulated through documentation and communication. All levels are responsible for configuration management performance.
	Conclusions:
	▪ AUA-400 plans and performs CM over the product's lifecycle for new systems. CM planning and performance is done according to the AUA-400 CM Plan. ▪ AOS-250 has adequately planned and managed the configuration of AWOS. AOS-250's modification records match the site FRDF records. AOS-250 persuades the IPT to provide maintenance and operational funding for the AWOS sites. ▪ The field has demonstrated varying efforts in planning and performing modifications for AWOS systems.
	Issues:
	▪ AUA-400 does not plan configuration management activities over the AWOS system's product lifecycle because AWOS is a legacy system that the contractor managed until AOS-250 gained control. The IPT CCB provides adjudication services on an as-needed basis. ▪ The contractor did not adequately plan and perform CM activities over the product lifecycle, as was evident when the FAA received the incomplete CM documentation. AOS-250 never received a product baseline that provided information and data on each AWOS site. AOS-250 maintains the baseline through telephone contact with facilities, since MMS does not provide accurate information. ▪ Facilities struggle to plan configuration management activities for AWOS, as the system is often a lower priority than other systems and resources are often unavailable. Technicians inconsistently perform CM activities, such as modification implementation and FRDF updates. Some Facilities did not implement modifications that AOS-250 distributed in 2000.
Core Attribute Four:	***Expectations:***
Configuration management activities are repeatable, measurable, and flexible.	▪ The flexibility and repeatability of configuration management activities allows organizations to tailor the process, within defined guidelines, to fit their needs. ▪ FAA Order 1800.66 states that organizations are responsible for using metrics to analyze and report the effectiveness of their CM activities.

Core Attribute Four (continued)	***Conclusions:***
	▪ AUA-400 tracks metrics as part of the requirements for iCMM Level 2 systems. Programs other than legacy systems are under iCMM process improvement. AUA-400 manages and collects metrics using the same Access database as AUA-200. ▪ AOS-250 has flexibility in their configuration management practices, which is shown in their ability to make lower level changes. ▪ AOS-250 uses automation and workflow tools to ensure that the process is repeatable. These tools also collect and report metrics on the change process in AOS-250. ▪ AUA-400 maintains basic metrics on their CM practices, which they track and report as part of iCMM Process Area 16 for Configuration Management.
	Issues:
	▪ The IPT, AOS, and Regional levels each collect different CM metrics to suit organizational needs. The FAA does not have an overall goal that drives the collection of metrics in the IPT, AOS, or the Regions. CM Metrics focus on improving processing time and identifying bottlenecks in the configuration management review process.
Core Attribute Five: Configuration items are uniquely identified and baselined, and the information is maintained in a repository.	***Expectations:*** ▪ The IPT develops and selects the program's lower level configuration items and lists these in the CCB Charter. IPTs are responsible for creating and maintaining baselines for configuration items and maintaining a repository of information regarding configuration items, known as a program support library. ▪ FAA Order 1800.66 states that the program support libraries for the IPTs, solution providers, and Regions will include technical baseline documents, guidance documents (plans, orders, etc.), and change vehicles.
	Conclusions:
	▪ AUA-400 does not have a product baseline for AWOS, but the IPT baselines new systems at the NAS level. ▪ AWOS documentation is located in the Document Control Center (DCC). AUA-400 does not own or manage any of that documentation since the system is fully deployed and is a legacy system. Documentation for newer programs is located in the product support library in hardcopy format. ▪ AOS-250 maintains all AWOS documentation in the AOS-200 division library. For AWOS, the only documentation held in a division library is the software source and object code. The AOS-200 website is another repository for system documentation. AOS-200 has documentation from the late 1990's on the site.

Core Attribute Five (continued)	***Issues:*** ▪ The vendor for AWOS never uniquely identified all of the configuration items or established a product baseline. Therefore, AOS-250 and AUA-400 received a system that did not have a baseline. ▪ The vendor did not maintain all of the proper documentation in a repository, and AUA-400 did not receive most of the AWOS documentation.
Core Attribute Six: Changes to NAS configuration are recorded, tracked, reviewed, approved, and reported.	***Expectations:*** ▪ The handling of changes to NAS configuration is an involved and lengthy process. Each level is responsible for accomplishing a number of configuration management tasks during the change process. Without each level working together to ensure the recording, tracking, reviewing, approving, and reporting of NAS changes, problems may arise.
	Conclusions: ▪ AUA-400 records, reviews, approves, and reports NAS Changes. ▪ AOS-250 records, reviews, approves, and reports changes. AOS-250 knew the AWOS configuration at every site the evaluation team visited. ▪ AWOS modification data was inconsistently tracked at the Facilities we visited. Although AWOS technicians knew that they should update MMS, they often did not do so. The data maintained in MMS and AOS-250 were inconsistent. ▪ Technicians did not install some AWOS modifications at the Facilities we visited. ▪ Most AWOS Facility personnel did not seem to understand that it was their responsibility to check MMS and AF Tech Net for modification information. ▪ Most AWOS technicians had not heard about AOS opening LEMs in MMS for technicians.
	Issues: ▪ The ability for AOS and modification coordinators in the Regions to track equipment is impaired when FSEP records incorrectly list Facilities as having equipment that they do not have. The evaluation team planned to visit two AWOS sites listed in the FSEP and on the AWOS website, but we found that the equipment was not installed at those sites. ▪ Facilities do not consistently report or track changes to AWOS. Some Facilities do not implement the system nor do they update MMS. The section of this appendix titled "Facility Configuration Management" describes the technicians' lack of modification implementation reporting and tracking.

Core Attribute Seven: Configuration audits and inspections, including contractor configuration management activities, are conducted and documented	***Expectations:*** ▪ During configuration audits and inspections, the IPTs' responsibilities include: ▪ Providing and storing information on NAS system development and deployment; ensuring that developing contractors provide and store CSA data ▪ Assembling the audit team ▪ Conducting the FCA/PCA ***Conclusions:*** ▪ AUA-400 never conducted a FCA and a PCA for AWOS. AUA-400 stated that newer systems must undergo a FCA and a PCA. ▪ AOS-250 does not conduct audits for AWOS. AOS-250 used the information from Y2K to get an idea of the configuration of fielded AWOS systems. ***Issues:*** ▪ Because the contractor controlled AWOS configuration management for much of the early product lifecycle, the evaluation team was not able to determine if the contractor conducted a FCA or a PCA.
Core Attribute Eight: Configuration Management training is provided	***Expectations:*** ▪ FAA Order 1800.66 addresses CM training at three levels: CM awareness (general familiarity with CM), CM comprehension (an understanding of CM), and Applied Knowledge (a level of CM understanding and capabilities that results in the skills and abilities to perform CM in the FAA). ***Conclusions:*** ▪ AUA-400 CM staff consists of certified CM practitioners that primarily use external development and training courses to improve their CM knowledge and skills. ▪ Facilities may request training from the Region when they are concerned about configuration management skills and activities. ***Issues:*** ▪ Technicians do not participate in CM training for AWOS when being certified to work on the system or at the Facility. Configuration management is not part of system certification training at the FAA Academy in Oklahoma City.

Enhanced Terminal Voice Switch Case Study

After deciding on AWOS and DSR for the configuration management case studies, the ACM-10 evaluation team was asked to also review the configuration management activities of the ETVS program. Because the evaluation team added ETVS after the completion of the planning stage, we were unable to gather as much information as the other case studies.

The evaluation team worked with the following organizations, which provided candid responses and useful ideas and recommendations on the configuration management process for ETVS. Those organizations included the IPT for Communication Systems (AND-300), the Product Team for ETVS (AND-320), Commercial Flight Systems, Weather, and Information Resources Management Division (AOS-510), AWP, and AEA. The team spoke with personnel involved with ETVS configuration management at two Facilities.

Enhanced Terminal Voice Switch Background

Enhanced Terminal Voice Switch is a Commercial off the Shelf (COTS) system composed of integrated communications switching systems. ETVS provides non-blocking voice communications between the air traffic control operator positions, radio channels, and interphone landlines. ETVS replaces obsolete electronic mechanical and aging electronic voice switching and recording systems in various Facilities.

Communications Integrated Product Team Level Configuration Management Practices

AND-300 is the organization responsible for the solution implementation of ETVS. In terms of configuration management, AND-300 processes and adjudicates changes to the ETVS baseline, along with any other systems that fall into the Communications IPT environment. The Communications IPT outlines its configuration management processes in its Configuration Management Plan. The CM Plan follows FAA 1800.66.

Communications Integrated Product Team Configuration Control Board

The AND-300 CCB adjudicates changes that affect the product baseline and elevates changes that affect interfaces with other systems to the NAS CCB for adjudication. The Communication IPT CCB provides the required documentation to ACM-20 for reporting. AND-300 also provides case file copies, CCB minutes, CCB agendas, and CCDs to ACM-20 for record maintenance and tracking. AND-300 provides CCB pre-briefings to the chairperson(s) of the Communications CCB to ensure that s/he will make a final approval/disapproval decision at the meeting. The Conclusions Section of this Appendix provides specific examples of how the AND-300 and the Communications IPT CCB carry out configuration management activities.

The evaluation team interviewed one member of the ETVS product team. AND-300 performed the up-front configuration management tasks before turning the system over to AOS. AOS-510 is now responsible for the system and manages the configuration management. The product team buys the modification kits for retrofits and sends the kits to AOS-510 after receiving them from the vendor. AOS-510 assembles the kits, sends them to the sites, and closes the action item. The product team feels that it knows the configuration of ETVS in the field because local changes are very difficult to make on this system. Most changes would render the system inoperable. The product team appeared to maintain adequate communication with AOS-510 for configuration management activities.

Operational Level Responsibilities

AOS-510 provides second level engineering support for voice switch systems. As part of its second level engineering support, AOS-510 reviews change requests and receives decisions from

CCDs adjudicated at the Communications CCB. AOS-510 stated that a primary responsibility is to retrofit ETVS systems. Retrofits ensure that older deployed systems are updated to reflect the same configuration as newly deployed systems. This requires the contractor to upgrade ETVS systems for the new configurations. These retrofits usually incorporate several software upgrades. When a retrofit occurs for deployed systems, the contractors and AOS visit the sites and perform the retrofit.

AOS-510 does not have a formal configuration management plan that outlines the second level engineers' responsibilities in configuration management. According to AOS-510 engineers, FAA Order 1800.66 is focused on configuration management during acquisition and is not as applicable to AOS' responsibilities. However, AOS-510 uses FAA Order 1100.57 as guidance for handling modifications and other engineering activities involving configuration management. FAA Order 1100.57 outlines AOS' roles and responsibilities for configuration management.

Previously, AOS-510 encountered communication difficulties on the ETVS program, as the vendor and the product team were making decisions without AOS' knowledge. Although the AOS-510 engineers knew they did not have authority to approve or disapprove of those decisions, they wanted to participate in the initial discussions. To facilitate this idea, AOS-510 worked to create a Configuration Review Board (CRB) for ETVS. The board includes AOS, AND, the vendor and other organizations with the purpose of providing an opportunity for ETVS engineers to participate in the discussions leading to the development of ECPs and retrofits.

Regional and Facility Level Responsibilities

The Regional and Facility levels have varying roles, responsibilities, and perceptions regarding configuration management. The Regional configuration management activities include Regional CM coordination and Regional CCB activities. At FAA Facilities, configuration management includes the implementation of modifications, maintenance of system documentation and record updates.

Regional Configuration Management Coordinators

The Regional CM Coordinator responsibilities remain the same regardless of the program discussed. Please see the DSR Case Study (page B-5) for information on Regional CM Coordinator responsibilities.

Regional Modification Coordinators

The Regional Modification Coordinator responsibilities remain the same regardless of the program discussed. Please see the DSR Case Study (page B-6) for information on Regional Modification Coordinator responsibilities.

Facility Configuration Management

The evaluation team spoke with two field technicians, an extremely small sample of field personnel, who are responsible for ETVS at specific Facilities. One of those technicians indicated that there have been no modifications for ETVS, while the other stated that the contractor and AOS schedule visits and perform configuration management activities, such as retrofitting the system. The contractor processes the retrofits as Engineering Change Proposals (ECPs); the field is not aware of any NCPs being processed for ETVS.

Based on discussions with the field, the contractor and AOS manage the majority of configuration management activities for ETVS systems by installing the retrofits and visiting the sites. The sites stated that they do not close out modification records because AOS knows the configuration of each system because AOS and the contractor implement the ECP or retrofit. Both sites were aware of upcoming ETVS modifications, and both sites knew the configuration of their ETVS.

The evaluation team searched the FSEP from AF TechNet. ETVS was not listed as a system in the FSEP, so we were unable to determine if the sites we visited were listed as having ETVS equipment installed. The FSEP may not contain ETVS data because the system is not fully deployed, although the majority of systems are operational in the field.

Conclusions

Core Attribute One: Configuration management practices result in requirements being traceable from the NAS level to the service and product levels.	***Expectations:*** ▪ The IPT is responsible for assisting ARS in tracing all decomposed system and subsystem requirements through the acquisition documentation to the contractor/vendor-generated documentation. This includes the establishment of a Traceability Matrix. The PT translates high-level system requirements from the fRD to a system level document that includes system, performance, detailed, and general specifications. ***Conclusions:*** ▪ AND-300 stated that the IPT uses the JRC-approved fRD to create the product specifications and testing procedures. The Communications CCB, as a Must Evaluator, is responsible for reviewing the documentation and baselines that come out of the IPT for traceability. Office of System Architecture and Investment Analysis (ASD) and ARS work with AND, as part of an extended IPT, to develop and assess the documentation such as the fRD. This allows for traceability. The PT translates high-level system requirements from the fRD to system level documentation.
Core Attribute Two: Configuration management strategy is established and roles and responsibilities are clearly defined and communicated.	***Expectations:*** ▪ FAA Order 1800.66 outlines the responsibilities for defining configuration management strategy and establishing roles and responsibilities at each level. AND-300 and Regional CM Coordinators place the CM strategies in their CM Plans. FAA Orders and other documentation communicate roles and responsibilities to the IPT, AOS, Regions, and Facilities. ***Conclusions:*** ▪ The AND-300 IPT has well defined CM roles and responsibilities in its CM Plan and the IPT CCB Charter. The IPT CCB Charter clearly defines its mission and responsibilities. ▪ AOS-350's roles and responsibilities are clearly communicated in FAA Order 6032.1B and FAA Order 1800.66. ▪ The Facility's roles and responsibilities are not well defined and communicated. Facilities know little about their roles and responsibilities regarding ETVS CM, since AOS and the contractor provide retrofits and upgrades. ETVS has not implemented modifications to date.

Core Attribute Two (continued)	***Issues:*** ▪ AOS-510 stated that there is no CM Plan that outlines the responsibilities of AOS. The IPT uses the contractor CM Plan, which does not always apply to AOS. Instead of using a CM Plan, AOS-510 uses FAA Order 1100.57, which outlines their roles and responsibilities across all FAA processes. AOS-510 does not know if AND-320 has a copy of FAA Order 1100.57.
Core Attribute Three: CM is planned and performed over the product's lifecycle	***Expectations:*** ▪ IPTs, AOS, and the Regions are responsible for configuration management planning, usually articulated through documentation and communication. All levels are responsible for configuration management performance.
	Conclusions: ▪ AND-320 has planned and performed configuration management activities over the product's lifecycle using the CM Plan that AND-300 established. AND-300's CM Plan outlines configuration control processes, interface management, configuration status accounting, and audits. ▪ AOS-510 received the ETVS documentation and system after the solution implementation was completed and the product baseline established. AOS-510 plans and performs retrofits with the contractor based on engineering changes. Technicians are aware of upcoming retrofits and are able to plan for the site visit of AOS and the contractor. ▪ The field is generally responsible for the management of the product from an availability standpoint. Because ETVS is difficult to reconfigure and AOS and the contractor provide upgrades, there is not much planning and support for ETVS.
Core Attribute Four: Configuration management activities are repeatable, measurable, and flexible.	***Expectations:*** ▪ The flexibility and repeatability of configuration management activities allows organizations to tailor the process, within defined guidelines, to fit their needs. ▪ FAA Order 1800.66 states that organizations are responsible for using metrics to analyze and report the effectiveness of their CM activities.
	Conclusions: ▪ The AND-300 CM Plan allows for a repeatable process. ▪ AND-300 maintains one metric, on processing time for NCPs. AND-300 manually calculates the processing time for all case files. ▪ The cooperation and coordination of AOS-510 and AND-320 in developing the Configuration Review Board demonstrates flexibility in configuration management activities for ETVS. ▪ AOS-510 collects metrics on configuration management. CCC Harvest, AOS' automated configuration management process tool, collects the metrics, although AOS does not use them to improve processes.

Core Attribute Four (continued)	***Issues:*** ▪ AND-300, AOS-510, and Regional levels each collect different metrics to suit organizational needs. The FAA does not have an overall goal or plan that drives the collection of metrics. Organizations currently use metrics to improve processing time and identify bottlenecks in the configuration management review process.
Core Attribute Five: Configuration items are uniquely identified and baselined, and the information is maintained in a repository.	***Expectations:*** ▪ The IPT develops and selects the program's lower level configuration items and lists these in the CCB Charter. IPTs are responsible for creating and maintaining baselines for configuration items and maintaining a repository for information regarding configuration items, known as a program support library. ▪ FAA Order 1800.66 states that the program support libraries for the IPTs, solution providers, and Regions will include technical baseline documents, guidance documents (plans, orders, etc.), and change vehicles.
	Conclusions: ▪ AND-300 identifies configuration items using their own process and identification key. ACM-20 identifies NCPs, and AOS identifies Testing Items. AND-300 maintains the relevant baselines and documentation until AOS-510 takes over the system after deployment. ▪ AND-300 does not have a database or repository for documentation and CM information. If other organizations need information, they must ask the CCB's Executive Secretariat. ▪ AOS-510 uses AOS-200's database, CCC Harvest, to maintain documentation. AOS-200 also provides space for handbooks and directives in the historical library and the change history library. AOS-200 has in internal website that AOS-510 posts information on so that users can retrieve the documentation online. ▪ Technicians stated that they maintain ETVS CM paperwork in the FRDF.
Core Attribute Six: Changes to NAS configuration are recorded, tracked, reviewed, approved, and reported.	***Expectations:*** ▪ The handling of changes to NAS configuration is an involved and lengthy process. Each level is responsible for accomplishing a number of configuration management tasks during the change process. Without each level working together to ensure the recording, tracking, reviewing, approving, and reporting of NAS changes, problems may arise.

Core Attribute Six (continued)	***Conclusions:***
	▪ AND-300 receives the NCP, reviews it, and submits it to the Must Evaluators. After Must Evaluator review, the Communications CCB approves the case file and reports the CCD action items to the appropriate offices. ▪ AND-300 uses telephone calls and site visits to ensure CCD action item closure. ▪ AOS-510, as part of the Configuration Review Board, reviews proposed ECPs and other changes. AOS-510 tracks changes differently than other AOS organizations because they implement the retrofit for each site rather than the technicians implementing the change and updating MMS. Therefore, AOS knows the status of modifications. ▪ Facilities, although they did not view MMS and the FRDF as configuration management activities, update their files when appropriate. ▪ The FSEP should list ETVS to ensure proper maintenance of the equipment.
Core Attribute Seven: Configuration audits and inspections, including contractor configuration management activities, are conducted and documented	***Expectations:*** ▪ During configuration audits and inspections, the IPTs' responsibilities include: ▪ Providing and storing information on NAS system development and deployment; ensuring that developing contractors provide and store CSA data ▪ Assembling the audit team ▪ Conducting the FCA/PCA
	Conclusions: ▪ AND-300 conducts FCAs and PCAs, as well as site surveys, for new programs. AND-300 conducts other audits when necessary. ▪ AOS-510 added status accounting paragraphs to the modification kits/documentation after Y2K forced the organization to review each site and each system for Y2K compliance. ▪ The Facilities stated that they do not participate in FCAs or PCAs, nor did they mention participating in any other audits.
Core Attribute Eight: Configuration Management training is provided	***Expectations:*** ▪ FAA Order 1800.66 addresses CM training at three levels: CM awareness (general familiarity with CM), CM comprehension (an understanding of CM), and Applied Knowledge (a level of CM understanding and capabilities that results in the skills and abilities to perform CM in the FAA).
	Conclusions: ▪ AND-300's Executive Secretariat stated that he has taken CM training from ACM-20 and external sources. AND-300 hosted a conference to inform the Regions about configuration changes and new systems.

Core Attribute Eight (continued)	***Issues:*** ▪ Facilities do not have a CM training plan, nor have they participated in any configuration management training activities.

Appendix C: Acronym List

AAF	Airway Facilities Service
ACM	NAS Configuration Management and Evaluation Staff
ACT	William J. Hughes Technical Center
AEA	Eastern Region
AFZ	Airway Facilities Resources Management Program
AFZ-700	NAS Planning and Support Division
AML	FAA Logistics Center
AMS	Acquisition Management System
AND	Office of Communications, Navigation, and Surveillance Systems
AND-300	IPT for Communications Systems
ANI	NAS Implementation Program
AOP	NAS Operations
AOP-100	NAS Operations Division
AOP-1000	NAS In-Service Management Division
AOS	Operational Support
AOS-200	National Airway Systems Engineering Division
AOS-300	National En Route Automation Division
AOS-350	Strategic Integration Systems Branch
AOS-500	Comm., Flight Services, Weather & Information Resource Management Division
AOS-510	Oklahoma City Communications Systems Engineering Support Branch
ARA	Research and Acquisitions
ARQ	Research and Requirements Directorate
ARS	Air Traffic System Requirements Service
ARTCC	Air Route Traffic Control Center
ASD	Office of System Architecture and Investment Analysis
ASO	Southern Region
ASOS	Automated Surface Observation System
ATB	Terminal Business Service
ATS	Air Traffic Services
AUA	Office of Air Traffic Systems Development
AUA-200	IPT for En Route Systems
AUA-400	IPT for Weather Systems
AWOS	Automated Weather Observation System
AWP	Western-Pacific Region
CAPB	Change Approval and Packaging Board
CCB	Configuration Control Board
CCD	Configuration Control Decision
CDP	Central Data Platform
CM	Configuration Management
CMSG	Configuration Management Steering Group
COTS	Commercial Off The Shelf
CR	Change Request
CRB	Configuration Review Board
CSA	Configuration Status Accounting
DCC	Document Control Center
DD-1000	NAS Level 1 Design Document
DOCCON	Documentation and Configuration Identification System
DOORS	Dynamic Object Oriented Requirements System
DOS	Disk Operating System
DR	Discrepancy Report
DSR	Display System Replacement

EC	Engineering Change
ECCB	Engineering Configuration Control Board
ECP	Engineering Change Proposal
EFSTS	Electronic Flight Strip Transfer System
EIA	Electronic Industries Alliance
ETVS	Enhanced Terminal Voice Switch
FAA	Federal Aviation Administration
FARM	Field Automated Requirements Management
FCA	Functional Configuration Audit
fRD	Final Requirements Document
FRDF	Facility Reference Data File
FSEP	Facility, Service, and Equipment Profile
HDR	Hardware Discrepancy Report
IA	Investment Analysis
iCMM	integrated Capability Maturity Model
ICMS	Integrated Control Management System
IDS	Information Display System
IPT	Integrated Product Team
IRB	Integrated Resolution Board
ISM	In-Service Management
ISMT	In Service Management Team
JRC	Joint Resources Council
LEM	Log Equipment Modification
MA	Mission Analysis
MMS	Maintenance Management System
MNS	Mission Needs Statement
NAS	National Airspace System
NCP	NAS Change Proposal
PCA	Physical Configuration Audit
PCCB	Program Configuration Control Board
PRB	Program Review Board
PSAT	Problem System Analysis Team
PT	Product Team
PTR	Program Trouble Reports
SAIDS	Systems Atlanta Information Display System
SI	Solution Implementation
SLE	Service Life Extension
SMO	Sector Management Office
SR-1000	NAS Requirements Specifications
SSC	System Support Center
SSD	System Support Directive
TCCS	Terminal Computer Control System
UHF	Ultra High Frequency
Y2K	Year 2000

Appendix D: Glossary

Note: All definitions taken directly from EIA-649 are marked with an asterisk (*). Definitions taken from the DSR ISMT CM Plan are marked with two asterisks (**). The evaluation team took most of the other definitions from FAA Order 1800.66, unless noted in a footnote.

Acquisition Management System[14]: Establishes policy and guidance for all aspects of the acquisition lifecycle from the determination of mission needs to the procurement and lifecycle management of products and services that satisfy those needs. AMS lifecycle phases include Mission Analysis, Investment Analysis, Solution Implementation, and In Service Management/ Service Life Extension

Action Item: Those responsibilities given to stakeholders in order to complete or close out a Configuration Control Decision (CCD). See Configuration Control Decision for complete definition

Action Office: The organization that receives the action item(s) from the CCB and must complete those items to close out an approved Configuration Control Decision (CCD)

Adjudication: A judicial decision from a Configuration Control Board (CCB) on the approval or disapproval of a change

AF TechNet: An Airway Facilities tool from which managers and technicians receive information and updates on equipment modifications from the National Modification Index and the National Modification Tracking Application. AF TechNet also notifies subscribers via email when AOS creates a new modification for particular systems

***Attributes**: Performance, functional, and physical characteristics of a product

***Baseline**: (1) An agreed-to description of the attributes of a product, at a point in time, which serves as a basis for defining change. (2) An approved and released document, or a set of documents, each of a specific revision; the purpose of which is to provide a defined basis for managing change. (3) The currently approved and released configuration documentation. (4) A released set of files consisting of a software version and associated configuration documentation

Capability Maturity Model: A descriptive model of the stages through which organizations progress as they define, implement, evolve, and improve their processes. This model serves as a guide for selecting process improvement strategies by facilitating the determination of the current process capabilities and the identification of issues most critical to quality and process improvement within a particular domain, such as software engineering or systems engineering

Case File: The documentation prepared by an organization originating a change to a NAS Configuration Item (CI). Prepared on FAA Form 1800-2, NAS Change Proposal, the case file is used during prescreening. A case file number is assigned by the originating office for status accounting purposes, and is the only number that identifies the proposed change until it has been forwarded for NCP number assignment

CCB Charter: Documentation that defines an approved CCB's authority, responsibilities, membership, and configuration items (CIs) under its jurisdiction

[14] *http://fast.faa.gov*

CCC Harvest: Automated software tool that assists AOS-200 by automating the configuration management process and the review of documentation

CCB Executive Secretariat: Provides administrative support to the CCB. The CCB Secretariat establishes the CCB's schedule and agendas; ensures necessary action is taken in processing all proposed changes for disposition by the CCB; maintains records for the CCB; and prepares minutes and action items for CCB meetings. CCB Operating Procedures: Detailed procedures that describe how a specific CCB manages its change management process

****Change Request (CR)**: Describes a change to the product's form, fit, or function and ultimately results in changing part of the system's baseline

CM Operating Procedure: A document that describes the standard procedures by which the respective organization will carry out their configuration management activities and responsibilities

CM Plan: The documentation of an IPT or solution provider's implementation of CM within the organization including CM planning, processes, and procedures commensurate with programs under its control. A CM Plan provides guidance in sufficient detail to allow tailoring of CM products for each life cycle phase

Configuration Management Steering Group (CMSG): An agency-wide forum of senior managers that guides the development, implementation, and operation of NAS configuration management

Commercial Off The Shelf (COTS): Something that one can buy, ready-made, from some manufacturer's virtual store shelf (e.g., through a catalogue or from a price list) with limited ability to make changes to the hardware or software

***Configuration Audit:** Product configuration verification accomplished by inspecting documents, products, and records; and reviewing procedures, processes, and systems of operation to verify that the product has achieved its required attributes (performance requirements and functional constraints), and the product's design is accurately documented. Sometimes divided into separate functional and physical configuration audits (FCA/PCA)

Configuration Control Board (CCB): The Agency-authorized forum for establishing configuration management baselines and for reviewing and acting upon changes to these baselines

Configuration Control Decision (CCD): The official notification of CCB decisions/directives signed by the CCB chair(s). The CCD contains specific action items that must be completed before the CCD is considered closed

Configuration Item: An aggregation of hardware/software/firmware, or any of its discrete portions, which satisfies an end-use function and is designated for configuration management

***Configuration Management (CM)**: A management process for establishing and maintaining consistency of a product's performance, functional, and physical attributers with its requirements, design, and operational information throughout its life

***Configuration Status Accounting (CSA)**: The configuration management activity concerning capture and storage of, and access to, configuration information needed to manage products and product information effectively

***Document Control Center (DCC)**: Maintained by NAS Configuration Management and Evaluation Staff (ACM), it is the principal repository and central ordering point for NAS documentation, including baselined documentation data. Items contained in the DCC include project specifications, NAS Orders and Standards and archived NCPs

Documentation and Configuration Identification System (DOCCON): A computer database that serves as a repository for documents under configuration management and provides the NAS CCB with traceability from NAS CCB-controlled configuration items to IPTs and documentation

DD-1000: The NAS Design Document written in the 1990's that defines the basic NAS elements, sub-elements, subsystems, and their interrelationships designed to support the FAA and its contractors in accomplishing major upgrades to the NAS[15]

****Engineering Change**: Approved change requests that result in cost proposal or technical changes in specifications, submitted by the contractor

Facility Baseline: Records and documents the physical layout of a NAS Facility, describing the physical plant (including space and power), installed systems and external interfaces as CIs that must be managed. Facility baseline data is the information needed to identify and control changes as well as record configuration and change implementation status. Facility baseline data normally consists of standard Facility drawings, Facility engineering data and Facility specifications

Facility Reference Data File (FRDF): A file of technical reference data on the characteristics and performance of FAA Facilities. This reference data serves as a historical record of Facility performance from the date of establishment to the date of decommissioning. The file data is updated as appropriate to reflect relevant changes, corrections or additions to the original information.

Facility, Service, and Equipment Profile (FSEP): An FAA listing of the equipment and Facilities within the NAS

Final Requirements Document (fRD): Establishes the functional and performance baselines and operational framework required by the sponsoring organization. The document becomes the basis for developing the requirements for the system specification and is baselined at the investment decision

****Hardware Discrepancy Report (HDR)**: Mechanism available to report hardware problems

In Service Management[16]: Begins when the new system, software, Facility, or service goes into operational use, and continues for as long as the product is in use. This phase is characterized by a continuing partnership among the providing, operating, and support organizations

Integrated Capability Maturity Model (iCMM): A process improvement model adopted in the FAA to guide advancements in agency processes and describe an improvement path

Integrated Product Team: Organization responsible for the management and acquisition of a particular set of capabilities to meet FAA goals and requirements

***Interface**: The performance, functional, and physical attributes required to exist at a common boundary.

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15 *DD-1000*

16 *http://fast.faa.gov*

***Life cycle**: A generic term relating to the entire period of conception, definition, build, distribution, operation, and disposal of a product

Log Equipment Modification (LEM): Database form for entering all NAS modifications into the Maintenance Management System (MMS)

Local Systems: Procurements made at the Regional or Facility level for operational solutions that meet local needs

Metrics: Measurements of indicators of the status of a project or procurement. Metrics are generally quantitative but can be qualitative as well

Modification: A change to a document or system resulting from the approval of a NAS Change Proposal (NCP), Problem Technical Report (PTR), Hardware Discrepancy Report (HDR), or other change mechanism

Modification Installation and Tracking: The process by which approved changes to operational NAS systems are implemented, including development and release of modification kits; preparation and distribution of modification documentation; update of logistics documentation and procurement/modification of spares; incorporation of changes at designated sites by authorized field technicians; and tracking of implementation status

Maintenance Management System (MMS)[17]: Fully automated logging system in which Facilities are to input the maintenance and modification activities performed on NAS equipment

Must Evaluation: After NCP number assignment, the process by which evaluators are assigned to a proposed change and review comments are collected and tracked

NAS Architecture: An evolutionary descriptive plan for the aviation, air traffic management and air navigation system in terms of services, functions and performance provided to the users

NAS Change Proposal (NCP): The means for baselining NAS CIs or proposing changes to baselined NAS CIs. Prepared on FAA Form 1800-2, an NCP identifies the CI to be baselined or modified, describes the recommended change and provides sufficient information so that the proposed change can be thoroughly evaluated

NAS Facilities: Real property or buildings owned or leased by the FAA, which house FAA equipment or provide a location for NAS services

NAS-Level Requirements: See NAS Technical Architecture

NAS-MD-001: A report of all baselined NAS subsystems/Facilities currently operational or under procurement for the NAS. It includes a listing of currently approved baseline documentation for these subsystems/Facilities

NAS Technical Architecture: The technical portion of the NAS Architecture, which defines and translates services, capabilities and implementation steps into design solutions and their required technical characteristics. The technical characteristics are defined as "NAS-Level Requirements," which explicitly translate the operational needs of the agency into functional, performance and constraint requirements that are sufficient to direct the appropriate design and

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17 *MMS SOP*

development of NAS systems. NAS-Level Requirements are the highest-level requirements maintained within the FAA and are initially used during Investment Analysis

Prescreening: The evaluation of case files for impacts on safety, ATC services, and other intangible benefits, as well as cost/benefits implications, to determine if the proposed change should be implemented

****Problem Trouble Report (PTR)**: Document that describes when the system does not meet its specifications

Program Support Library (PSL): A centralized repository for program documentation that contains technical baseline documents (specifications, Interface requirement documents (IRDs), interface control documents (ICDs), etc.), change vehicles (NAS Change Proposals (NCPs), Engineering Change Proposals (ECPs), etc.), guidance documents (plans, processes and standards, etc,) and other information needs required by stakeholders

Regional CM Coordinator: Serves as the regional focal point for configuration management including the coordination and review of case files and NCPs

Requirements Traceability: Addresses the relationship between requirements at the highest level (i.e., conceptual) through the lowest level (i.e., physical); it describes the activities associated with decomposing the requirements from the highest to the lowest level and documenting them so that a full impact analysis (upward and downward) can be performed when changes are proposed

****Scrubbed**: Occurs to case files that a designated group assesses for technical validity, cost, and urgency

Sector Management Office (SMO): Responsible for a group of Facilities in ensuring that safety and equipment is maintained

Site Survey: A review of actual equipment and infrastructure elements of a site/location conducted to gather information or establish a baseline

***Specification**: A document that explicitly states essential technical attributes/requirements for product and procedures to determine that the product's performance meets its requirements/attributes

Stakeholder: Organization(s) with technical, financial, or other interest in the progress and configuration of a document or system

Systems: Hardware, software, or a combination thereof that provide a solution for NAS requirements

System Support Modification (SSM): A change implementation directive used to change an operational baseline.

System Support Directive (SSD): A type of change implementation directives used to change an operational baseline. A SSD can be one of the following types: System Support Modification (SSM), System Technical Release (STR), or a System Documentation Release (SDR)

SR-1000: A compilation of requirements that describe the operational capabilities for the NAS as envisioned to exist by the year 2000; used to support the NAS design, engineering, and acquisition activities and to manage and control the NAS[18]

[18] *SR-1000*

WebCM: An automated tool currently being designed to support configuration management automation for stakeholders throughout the NAS